Altivar™ Plus for Compressor Applications User's Manual

125–900 hp

Instruction Bulletin

NHA65138
08/2015

Retain for future use.

Schneider Electric™

Hazard Categories and Special Symbols

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **can result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury. The safety alert symbol is not used with this signal word.

NOTE: Provides additional information to clarify or simplify a procedure.

Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

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Section 1—Precautions and Terminology

Installation and Maintenance Precautions

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand this manual before installing or operating the enclosed drive. Installation, adjustment, repair, and maintenance must be performed by qualified personnel.
- The user is responsible for compliance with all international and national electrical code requirements with respect to grounding of all equipment.
- Many parts of this enclosed drive, including the printed circuit boards, operate at the line voltage. DO NOT TOUCH. Use only electrically-insulated tools.
- DO NOT touch unshielded components or terminal strip screw connections with voltage present.
- DO NOT short across terminals PA/+ and PC/- or across the DC bus capacitors.
- Before servicing the enclosed drive:
  - — Disconnect the power, including the external control power that may be present. The circuit breaker or disconnecting switch does not always open all circuits.
  - — Lock the circuit breaker or disconnecting switch in the opened position.
  - — Place a “DO NOT TURN ON” label on the circuit breaker or disconnect switch of the enclosed drive.
  - — Wait 15 minutes to allow the DC bus capacitors to discharge. Then follow the “DC Bus Voltage Measurement Procedure” on page 34 to verify that the DC voltage is less than 42 V. The enclosed drive LED is not an indicator of the absence of DC bus voltage.
- Install and close all covers before applying power or starting and stopping the enclosed drive.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

DAMAGED ENCLOSED DRIVE

- Do not install or operate any enclosed drive that appears damaged.
- If you find shipping damage, notify the carrier and your Schneider Electric sales representative.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

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⚠ CAUTION

RISK OF BURNS AND ROTATING FAN BLADES

- Make sure that the device is sufficiently cooled and that the permitted ambient conditions are maintained.
- Do not touch components inside the enclosure. Heat sinks, chokes, and transformers remain hot after removing power.
- Before opening the enclosure, ensure that the fans are not running. After switching off the voltage supply, the device fans may continue running for some time.

Failure to follow these instructions can result in injury or equipment damage.

Operation Precautions

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Before working on this equipment, turn off all power supplying it and perform the “DC Bus Voltage Measurement Procedure” on page 34.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

UNQUALIFIED PERSONNEL

- This equipment must be installed and serviced only by qualified personnel.
- Qualified personnel performing diagnostics or troubleshooting that requires electrical conductors to be energized must comply with:
  - NFPA 70 E® – Standard for Electrical Safety Requirements for Employee Workplaces®
  - CSA Z462 – Workplace Electrical Safety
  - OSHA Standards – 29 CFR Part 1910 Subpart S Electrical
  - NOM-029-STPS – Maintenance of Electrical Installation in the Workplace, Safety Conditions
  - Other national and local electrical codes that may apply

Failure to follow these instructions will result in death or serious injury.

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⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Properly ground the enclosed drive before applying power.
- Close and secure the enclosure doors before applying power.
- Certain adjustments and test procedures require that power be applied to this enclosed drive. Extreme caution must be exercised as hazardous voltages exist. The enclosure door must be closed and secured while turning on power or starting and stopping this enclosed drive.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

INCOMPATIBLE LINE VOLTAGE

Before powering up and configuring the enclosed drive, ensure that the line voltage is compatible with the supply voltage shown on the enclosed drive nameplate. The enclosed drive may be damaged if the line voltage is not compatible.

Failure to follow these instructions can result in injury and/or equipment damage.

Terminology

The following terminology is used throughout this instruction bulletin to distinguish between the 08/2015Altivar Plus enclosed drives and the Altivar 61/71 components.

- **Enclosed drive** refers to the combination of the drive, enclosure, and the power and control circuits that constitute the Altivar Plus enclosed drive.
- **Drive**, as used in this manual, refers to the controller portion of the adjustable speed drive as per the NEC.

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Section 2—Introduction and Technical Characteristics

Introduction

Schneider Electric's Altivar™ Plus enclosed drives feature the Altivar 61 and Altivar 71 adjustable frequency drives, providing a robust, packaged, adjustable speed solution for commercial, industrial, and municipal applications.

This instruction bulletin covers receiving, installation, start-up, configuration, operation, and troubleshooting of Altivar Plus enclosed drives.

Supplied Documentation

The Altivar Plus enclosed drives include factory-supplied user drawings and are identified by a factory order number. The factory order number for the enclosed drive appears on the nameplate (see Figure 1 on page 15). This same number appears as part of the number sequence in the title block of the factory-supplied user drawings. The drawing set includes:

- An enclosure outline drawing
- Electrical schematic drawings
- A component layout drawing

To replace documents, contact your local Schneider Electric field office.

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Related Documentation

For further information, refer to the latest revision of the instruction bulletins listed in Table 1. These documents ship with the drive when the corresponding option is selected and are available from the Technical Library at www.schneider-electric.com.

Table 1: Instruction Bulletins

Bulletin No.	Title
1755849 (HD) or 1760655 (ND)[1]	*Installation Manual*, 75–100 hp, 230 V and 125–700 hp, 460 V
1755855 (HD) or 1760649 (ND)	*Programming Manual*
1755861 (HD) or 1760661 (ND)	*Communication Parameters*
30072-200-50	*Handling, Installation, Operation, and Maintenance of Electrical Control Equipment*
S1B86974	*ATV61 Quick Start Guide*
S1B86982	*ATV71 Quick Start Guide*
1760649	*ATV61 Programming Manual*
1755855	*ATV71 Programming Manual*
1760661	*ATV61 Communication Parameters Manual*
1755861	*ATV71 Communication Parameters Manual*
1755863	*ATV71 Integrated Modbus™ Manual*
1755867	*ATV71 Uni-Telway™ Manual*
1755875	*ATV71 Modbus with Uni-Telway Manual*
1765273	*ATV61 LonWorks™ Card manual*
1765274	*ATV61 BACnet™ Manual*
1755877	*ATV61/71 DeviceNet™ Manual*
AAV33578	*ATV61 Metasys™ N2 Manual*
BBV10543	*ATV61 Apogee™ FLN P1 Manual*
1755871	*ATV61/71 Interbus™ Manual*
1755873	*ATV61/71 Profibus™ DP manual*
AAV52935	*ATV61/71 Profibus DPv1 Manual*
1757062	*ATV61/71 Controller Inside Manual*
1755865	*ATV61/71 CANopen™ Manual*
AAV68822	*ATV61/71 Ethernet-IP Manual*
1755879	*ATV61/71 Ethernet - Modbus TCP-IP Manual*
AAV69931	*ATV61/71 Modbus TCP/IP Manual - Daisy Chain EtherNet Card Manual*
HRB10064	*ATV61/71 Modbus TCP Manual VW3A3320*
HRB10065	*ATV61/71 Ethernet IP Manual VW3A3320*
1494409	*ATS48 User manual*
VVDED302023	*ATS48 Modbus Protocol User's Manual*

[1] ND: Normal duty; HD: Heavy duty.

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Technical Specifications

Table 2: Electrical Specifications

Input mains voltage	480 Vac ±10%, 600 Vac ±10% (other voltages on request)
Short circuit current rating (AC symmetrical)	100 kA symmetrical short circuit current rating up to 500hp, No Bypass 65 kA symmetrical short circuit current rating up to 700 hp with Bypass
Control voltage	24 Vdc (regulated, supplied by drive); 115 Vac +10%/-15% (control power transformer included)
Displacement power factor	98% through speed range (in AFC operation mode)
Input frequency	50/60 Hz ± 5%
Output voltage	Three-phase output; maximum voltage equal to input voltage
Galvanic isolation	Galvanic isolation between power and control (inputs, outputs, and power supplies)
Output frequency range of drive	0.1 to 500 Hz (factory setting of 60 Hz)
Torque overload	**Normal Duty:** 110% of nominal motor torque for 60 s**; Heavy Duty:** 150% of nominal motor torque for 60 s
Current (transient)	**Normal Duty:** 110% of drive rated current for 60 s**; Heavy Duty:** 150% of drive rated current for 60 s
Switching frequency	Selectable from 0.5 to 8 kHz. Factory setting: 2.5 kHz The drive reduces the switching frequency automatically in the event of excessive heat sink temperature.

Table 3: Environmental Specifications

Storage temperature	-13 to +158 °F (-25 to +70 °C).
Operating temperature	+14 to +104 °F (-10 to 40 °C). For 125 hp and higher (460 V) operating between 40 and 50 °C, derate the current 3.3% per °C above 40 °C.
Humidity	95% with no condensation or dripping water, conforming to IEC 60068-2-78.
Altitude	3,300 ft (1000 m), without derating and: • All 460 V equipment, derate the current by 1% for each additional 330 ft (100 m) up to 9,842 ft. (3000 m) maximum • All 575 V equipment, derate the current by 1% for each additional 330 ft (100 m) up to 6,560 ft. (2000 m) maximum • When an integral softstart bypass (D08) is selected, derate the current by 2.2% for each additional 330 ft (100 m) up to 6,560 ft. (2000 m) maximum
Enclosure	UL Type 12: Dust-tight (ventilated)
Pollution degree	Pollution degree 2 or 3 per NEMA ICS-1 Annex A and IEC 60664-1
Operational test vibration	Conforming to IEC 60721-3-3-3M3 amplitude; 1.5 mm peak to peak from 3 to 13 Hz; 1 g from 13 to 200 Hz
Transit test to shock	Conforming to National Safe Transit Association and International Safe Transit Association test for packages.
Operational shock	15 g, 11 ms
Codes and standards	UL/cUL Listed per UL 508A; IEEE519 Compliant (harmonic input filter required); Conforms to applicable NEMA ICS, NFPA, and IEC standards; Manufactured under ISO 9001 standards.

Table 4: Operation and Control

Speed reference	**AI1:** 0 to +10 V, Impedance = 30 kΩ. Can be used for speed potentiometer, 1–10 kΩ. **AI2:** Factory setting: 4 to 20 mA. Impedance = 242 Ω (reassignable, X–Y range with graphic display terminal).
Frequency resolution in analog reference	0.1 for 100 Hz (11 bits)
Speed regulation	V/f control: equal to the motor's rated slip. SFVC: 10% of the motor's rate slip from 20% to 100% of nominal motor torque.
Efficiency	95% (or greater) at full load typical
Reference sample time	2 ms ±0.5 ms
Acceleration and deceleration ramps	Drive: 0.1 to 999.9 s (definition in 0.1 s increments); Softstarter: 1 to 60 s (definition in 1 s increments)
Graphic display terminal	Self diagnostics with trip indication messages in three languages; also refer to the Programming Manual(s) available online at www.schneider-electric.com.

Table 5: Protection

System protection	• Thermal protection of drive, input passive filter, and starter • Phase loss of AC mains • Fuse protected
Motor protection	Class 10 electronic overload protection (drive) Class 10 or 20 bypass overload protection (with bypass) Motor phase loss protection

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Standard Features

Altivar Plus enclosed drives include:

- Pre-engineered, ready-to-use solutions in highly efficient designs
- UL Type 12 enclosures
- Large swiveling control panel for customization of drive controls
- Rail-mounted drive for easy maintenance
- Altivar Plus enclosed drive with Altivar 71
  - 125–700 hp, 460 Vac
  - 125–700 hp, 575 Vac
- Altivar Plus enclosed drive with Altivar 61
  - 125–900 hp, 460 Vac
  - 125–800 hp, 575 Vac

List of standard features:

- UL/cUL Listed per UL508A
- 100 kA short circuit rating (460 V) without bypass
- Overcurrent protection device
- Disconnect handle with lock/out tag-out provisions
- Non bypass
- 3% line reactor
- 0–10 Vdc or 4–20 mA speed reference input
- 0–10 Vdc or 4–20 mA programmable output
- Door mounted graphic display terminal
- Auto-Start relay (120 Vac control)
- Permanent wire markers
- 4 in. Plinth
- Accommodations for remote shunt tripping of main disconnects
- Accommodations for remote tripping of drive and softstarter
- Accommodations for supplying 120 Vac to the motor winding heater (up to 500 VA)
- 3 kVA control power transformer
- Door mounted reset pushbutton
- Cooling fan adjustable off-delay timing

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Factory Modifications

Refer to Table 6 for the list of parts included with each factory modification.

NOTE: Legend plate part numbers beginning with 65170 are not available as a separately-ordered part. Contact your local field sales office.

Power Options

Table 6: Parts List for Bypass Circuit Selector Switches

Part	Part No.	Description
AFC-Off-Bypass Selector Switch	65170-166-43	Engraved legend plate “AFC-Off-Bypass”
	ZBZ32	Legend plate holder
Pushbutton Enclosure	XAPA1110	—

Additional Options

- 5% Line Reactor
- Surge Suppressor
- DV/DT Filter
- Harmonic Filter
- Softstart Bypass
- Full Voltage Bypass
- Line Contactor
- Top Entry Cubicle
- 8 in. Plinth

For other options contact your local field sales office.

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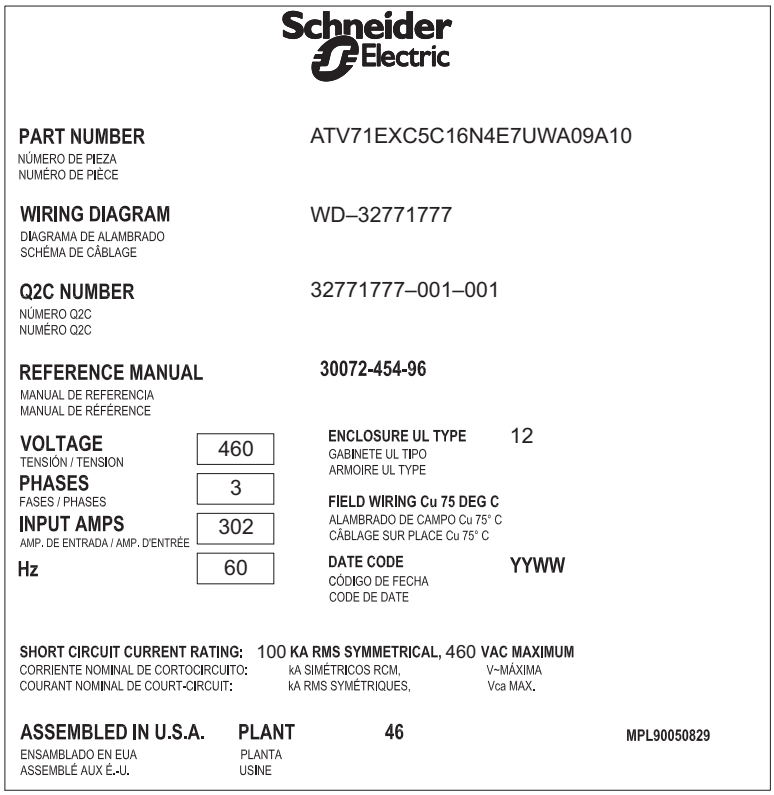
Section 3—Handling, Installation, and Commissioning

Receiving and Handling

Inspect the enclosed drive before storing or installing it. Upon receipt:

- Remove the enclosed drive from its packaging and visually inspect the exterior for shipping damage.
- Ensure that the part number on the nameplate matches the part number on the packing slip and purchase order. See Figure 1 for a nameplate example.
- If you find shipping damage, notify the carrier and your Schneider Electric sales representative.

Figure 1: Nameplate Example



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Storage

Store the enclosed drive in its original packaging until it reaches its final installation site. This helps protect the equipment and helps prevent damage to its exterior.

- Storage temperature: –25 °C to +70 °C (–13 °F to +158 °F)

NOTICE

- If the enclosed drive is not switched on for a long period, the performance of its electrolytic capacitors will be reduced.
- If it is stopped for a prolonged period, turn the enclosed drive on every two years for at least 5 hours to restore the performance of the capacitors, then check its operation. Do not connect the enclosed drive directly to the line voltage. Increase the voltage gradually using an adjustable AC source.

Failure to follow these instructions can result in equipment damage.

Mechanical Installation

Unpacking the Altivar Plus Enclosed Drives

Altivar Plus enclosed drives are shipped standing up and may have a high center of gravity, which can cause them to tilt and fall. Fork trucks provide a convenient method of moving floor-mounted equipment.

⚠ WARNING

UNSTABLE LOAD

- Use extreme care when moving heavy equipment.
- Verify that the moving equipment is rated to handle the weight.
- When removing equipment from a shipping pallet, carefully balance and secure it using a safety strap.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Before installation:

1. Open the drive door by moving the main disconnect handle to the OFF position.
2. Visually verify that all internal mounting and terminal connection hardware is properly seated, securely fastened, and undamaged.
3. Visually verify that the control board and any communication boards on the drive are properly seated, securely fastened, and undamaged. Verify that the internal plugs and wiring connections are tight. Inspect all connections for damage.
4. Verify that all relays and fuses are installed and fully seated.
5. Close and secure the enclosed drive door.

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Handling the Enclosed Drive

⚠ WARNING

HANDLING AND LIFTING HAZARDS

- Keep the area below any equipment being lifted clear of all personnel and property.
- Lifting the enclosed drive requires the use of a lifting apparatus. Use the lifting method shown in Figures 2 and 3 on page 18.
- Before lifting the enclosed drive:
  - — Inspect the lifting plates, holes, slots, and eyebolts for any damage.
  - — Keep the lifting force vertical.
  - — Limit the sling angle to less than 60°.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Handle the enclosed drive carefully to avoid damage to the internal components, frame, or exterior. When handling the enclosed drive, balance it carefully to keep it from tipping. The enclosed drive is equipped with eyelets or lifting rails to facilitate handling with a hoist. It also has a provision for a crane hook that can be removed after final placement.

When handling the enclosed drive:

- Always work with another person. The weight, size, and shape of the enclosed drive is such that two people are required to handle it.
- Wear gloves.
- Use a hoist or a crane.
- Place the enclosed drive in an upright position.

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Figure 2: Lifting with a Hoist (Frame B)

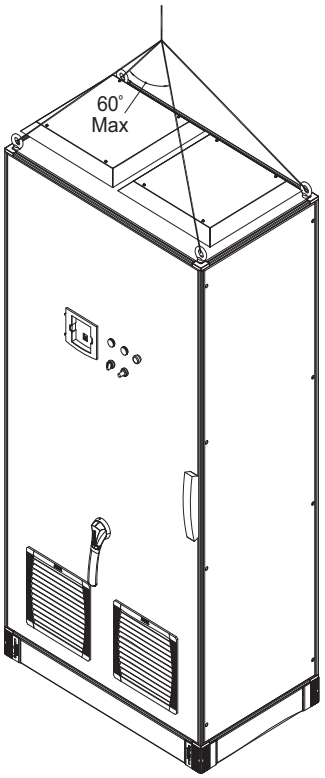
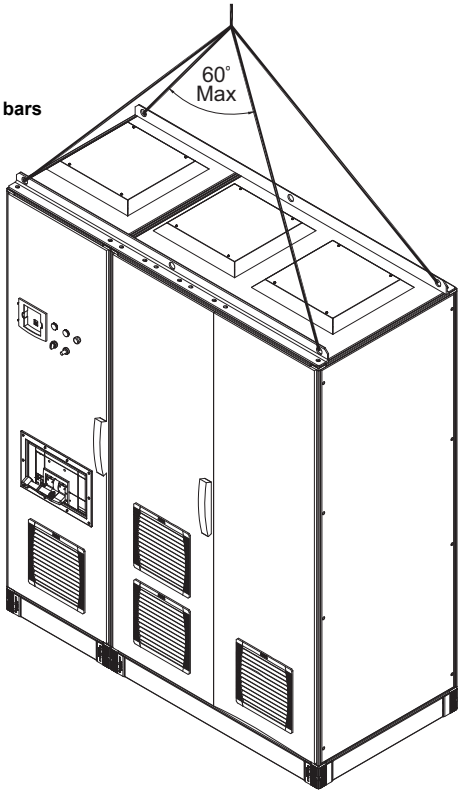


Figure 3: Lifting with a Hoist (Frame C)



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⚠ WARNING

IMPROPER MOUNTING

Before removing the lifting mechanism:

- Ensure that all mounting hardware is of a sufficient size and type for the enclosed drive weight.
- Secure and tighten all mounting hardware.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Floor-Mounting the Enclosed Drive

⚠ WARNING

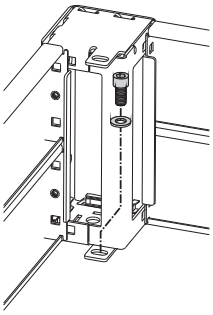
INCREASED RISK OF TOPPLING

Secure the enclosed drive to the floor with mounting hardware at the final position.

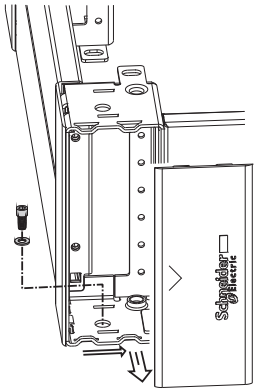
Failure to follow these instructions can result in death, serious injury, or equipment damage.

- Mount the enclosed drive on a flat, solid surface capable of supporting its weight.
- Mount the enclosed drive in a location that provides air access into the lower front of the enclosed drive.
- Do not mount the enclosed drive on hot surfaces or in direct sunlight.
- Secure all four corners of the enclosed drive with hardware of a sufficient size and type for its weight.
- If drilling for conduit entry, take care to prevent metal chips from falling on parts and electronic printed wiring boards.
- See Figures 5–10 on pages 21–26 for mounting dimensions.
- When cleaning the interior and exterior of the enclosed drive, use a vacuum. Do not use compressed air, as it may blow contaminants into other parts of the enclosed drive.
- Check the enclosure for damage that might reduce electrical clearances.

Figure 4: Mounting Hole Location for Floor Mount



Securing the enclosed drive to the floor from the inside



Securing the enclosed drive to the floor from the outside

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Total Dissipated Watts Loss

The total dissipated watts loss in Tables 7 and 8 is provided for sizing the environment HVAC cooling requirements based upon worst-case operating conditions for Type 12 enclosures.

Table 7: Maximum Total Dissipated Watts Loss, 460 V[1]

	Heavy Duty (Altivar 71)					Normal Duty (Altivar 61)				
Controller Catalog No.	**kW (Code)**	**hp**	**Total Dissipated Watts Loss 3% Line Reactor**	**Total Dissipated Watts Loss 5% Line Reactor**	**Total Dissipated Watts Loss Passive Harmonic filter**	**kW (Code)**	**hp**	**Total Dissipated Watts Loss 3% Line Reactor**	**Total Dissipated Watts Loss 5% Line Reactor**	**Total Dissipated Watts Loss Passive Harmonic filter**
ATV•EXC5•N4E7UW	D90	125	2707	2727	3549	D90	125	2369	2389	3211
	C11	150	3075	3135	4119	C11	150	2863	2923	3907
	C13	200	3521	3661	4755	C13	200	3509	3649	4743
	C16	250	4199	4410	5405	C16	250	4423	4634	5629
	C20	300	5361	5766	6912	C22	350	5997	6282	7669
	C25	400	6393	6653	8060	C25	400	6899	7159	8566
	C28	450	7388	7653	9388	C31	500	8435	8614	10426
	C31	500	8022	8201	10013	C40	600	10396	10894	12419
	C40	600	10089	10587	12112	C50	700	12977	13559	15268
	C50	700	12267	12849	14558	C63	900	16178	16926	19457

Table 8: Maximum Total Dissipated Watts Loss, 575 V[1]

	Heavy Duty (Altivar 71)				Normal Duty (Altivar 61)			
Controller Catalog No.	**kW (Code)**	**hp**	**Total Dissipated Watts Loss 3% Line Reactor**	**Total Dissipated Watts Loss 5% Line Reactor**	**kW (Code)**	**hp**	**Total Dissipated Watts Loss 3% Line Reactor**	**Total Dissipated Watts Loss 5% Line Reactor**
ATV•EXC5•Y6E7UW	C11	125	2631	2751	C11	125	2636	2756
	C13	150	3042	3194	C13	150	3054	3206
	C16	175	3663	3787	C16	175	3679	3803
	C20	200	4397	4521	C20	200	4423	4547
	C25	250	5586	5670	C25	250	5603	5687
	C31	350	6817	6882	C31	350	6832	6897
	C40	450	8119	8167	C40	450	8074	8122
	C50	550	10412	10644	C50	550	10457	10689
	C63	700	12919	13049	C63	700	12952	13082
	—	—	—	—	C80	800	15959	16239

[1] To convert to BTU/hr, multiply Watts Loss by 3.41.

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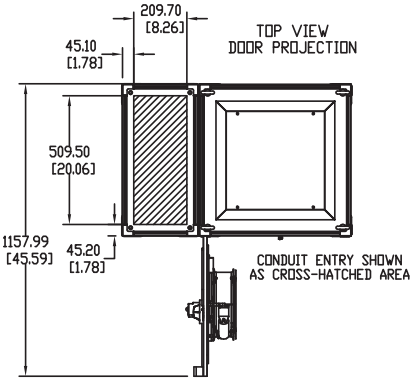
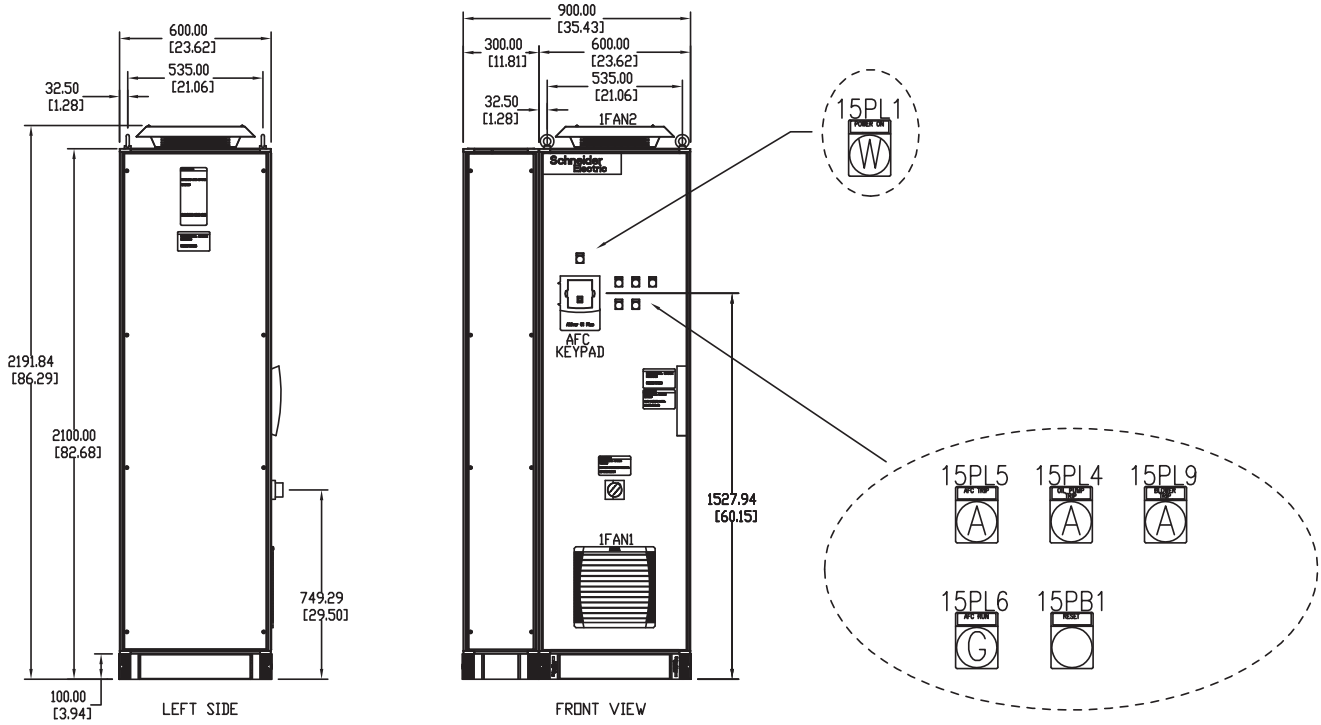
Mounting Dimensions and Typical Mounting Locations

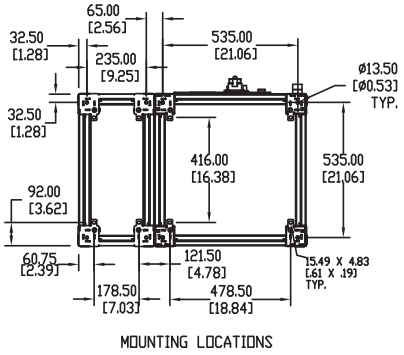
Figure 5: Frame Size A Enclosure: 125–250 hp Normal Duty and 125–200 hp Heavy Duty @ 460 V, 125–200 hp Normal Duty and 125–175 hp Heavy Duty @ 575 V, Circuit Breaker for 460 V, Fusible Disconnect for 575 V

DIMENSIONS: mm / [in.]

APPROXIMATE WEIGHT: 850–1100 lb.







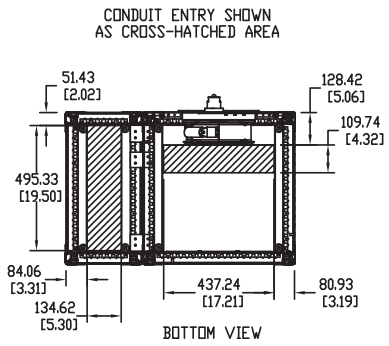


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Figure 6: Frame Size A Enclosure with SS Bypass

DIMENSIONS: mm / [in.]

APPROXIMATE WEIGHT: 1100–1400 lb.

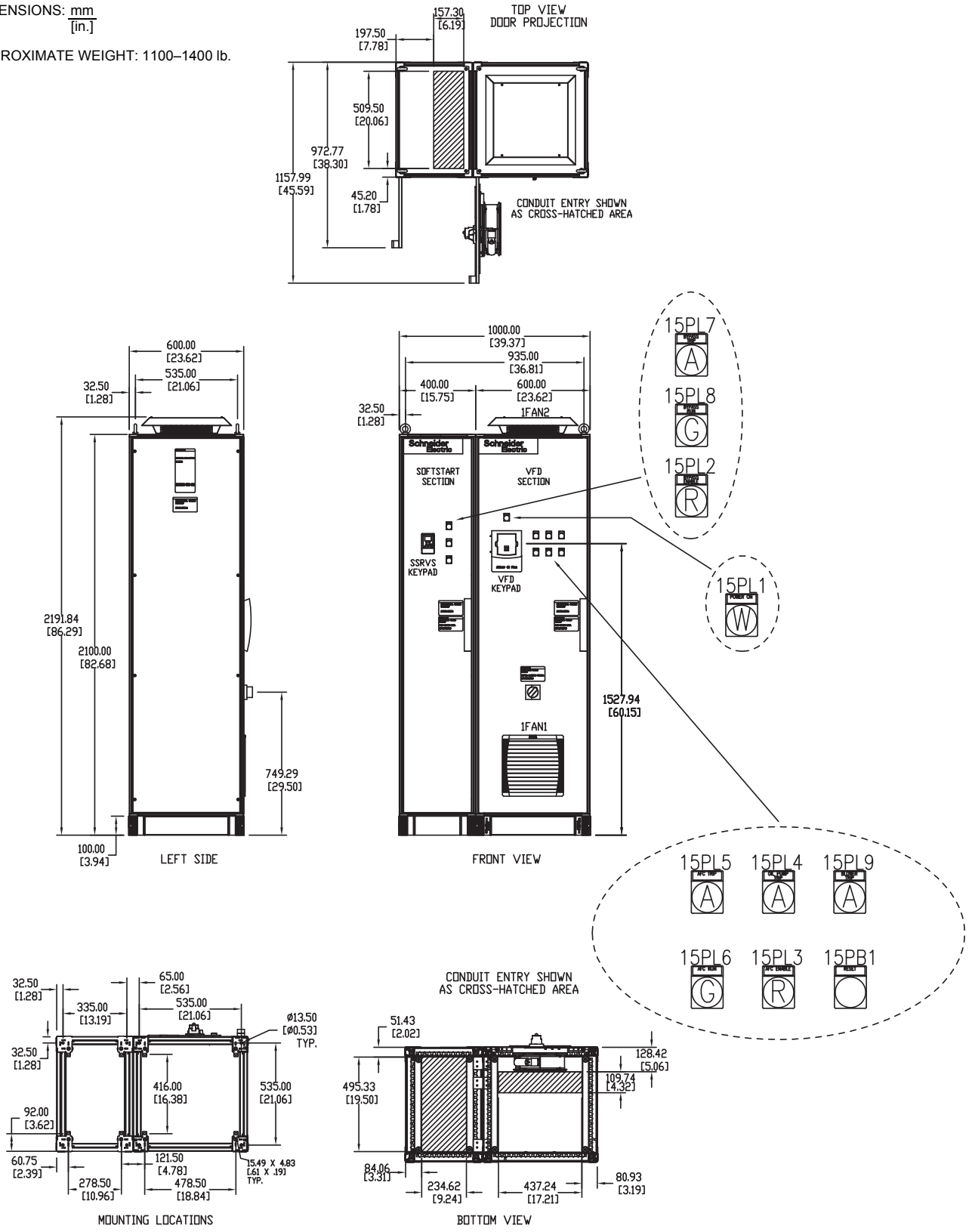

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Figure 7: Frame Size B Enclosure: 350–500 hp Normal Duty and 250–450 hp Heavy Duty @ 460 V, 250–450 hp Normal Duty and 200–350 hp Heavy Duty @ 575 V, Fusible Disconnect for 460 V and 575 V

DIMENSIONS: mm / [in.]

APPROXIMATE WEIGHT: 1200–1700 lb.

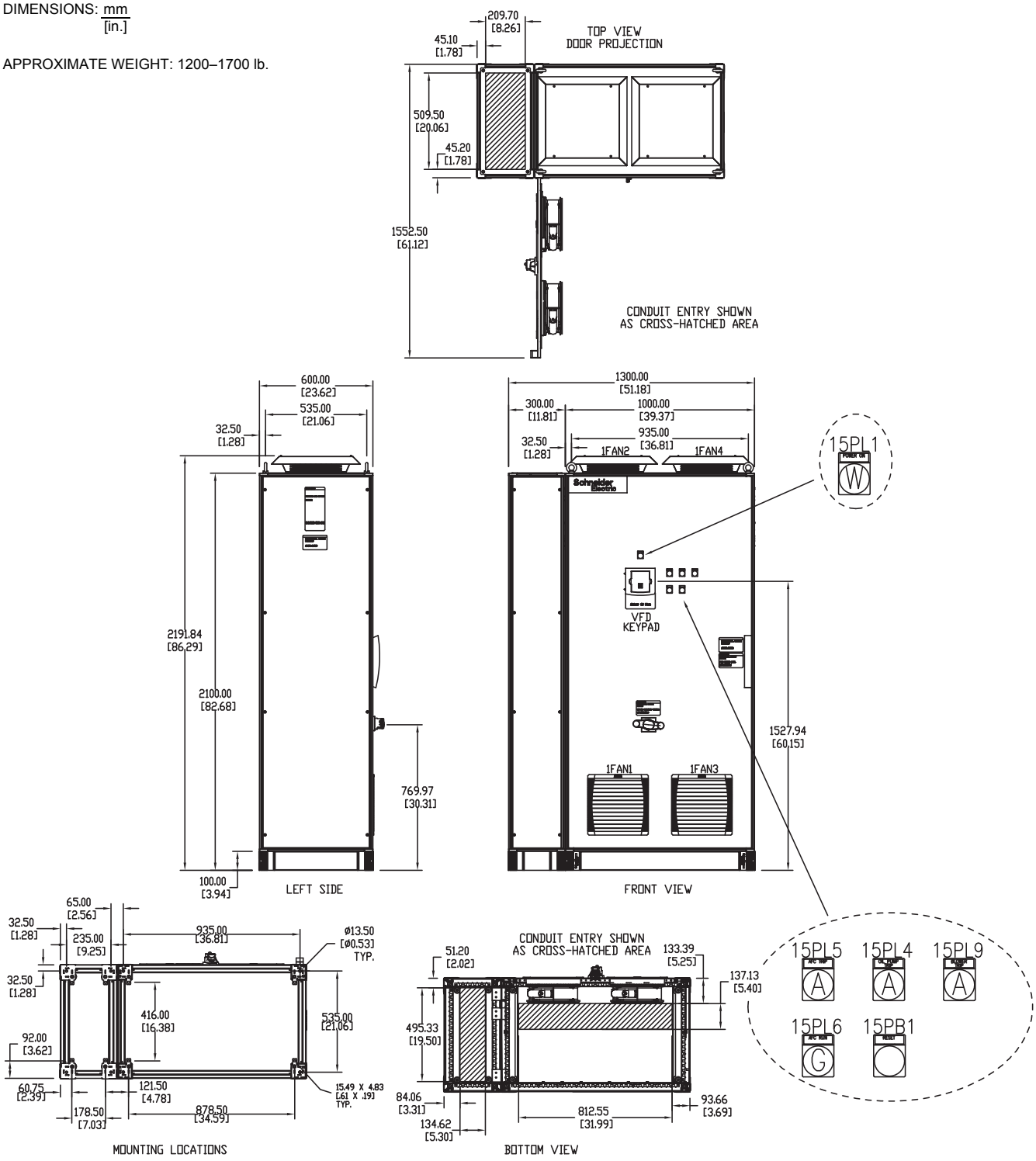

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Figure 8: Frame Size B Enclosure with SS Bypass

APPROXIMATE WEIGHT: 1750–2500 lb.

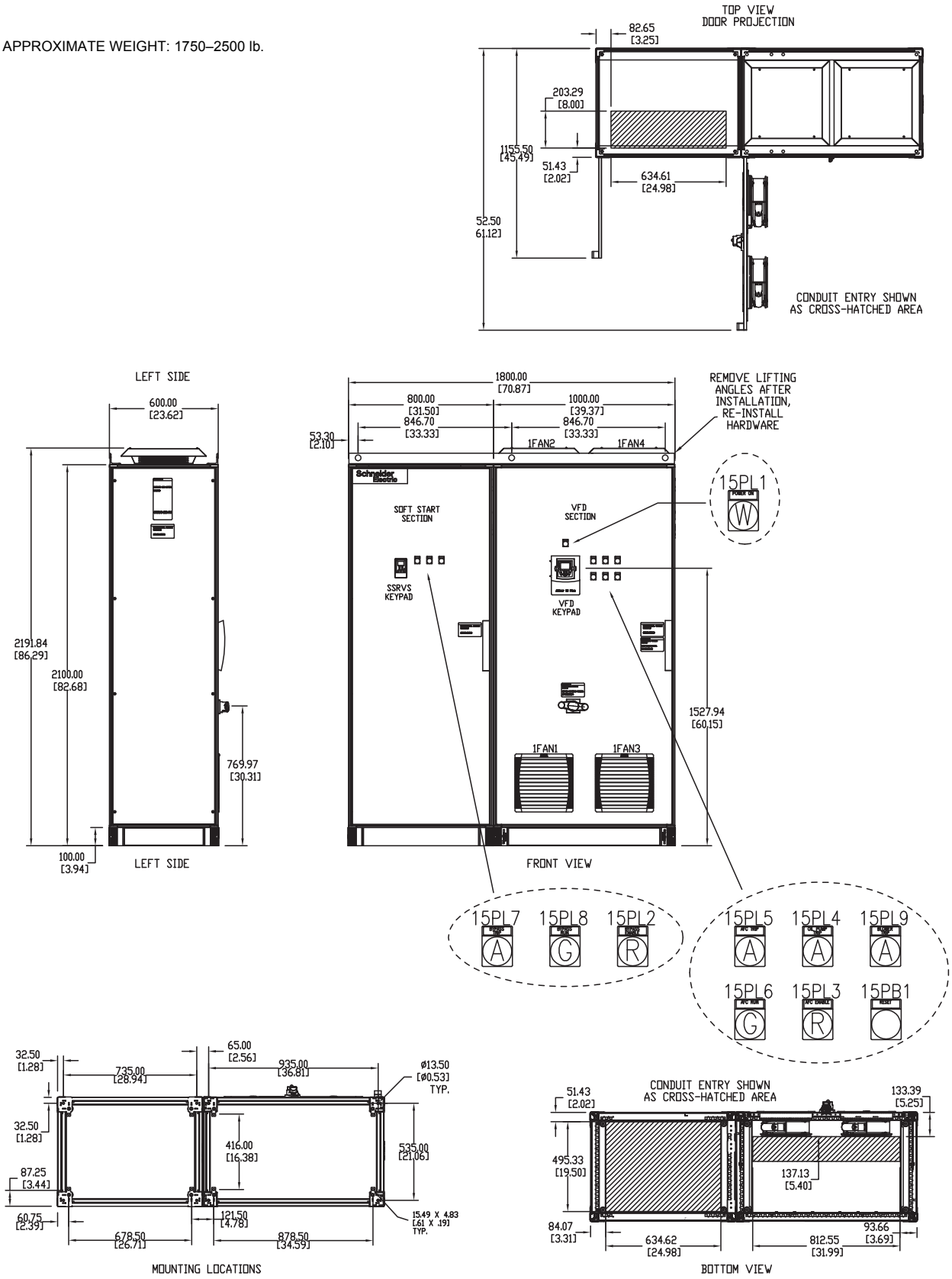

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Figure 9: Frame Size C Enclosure: 600–900 hp Normal Duty and 500–700 hp Heavy Duty @ 460 V, 550–800 hp Normal Duty and 450–700 hp Heavy Duty @ 575 V, Circuit Breaker for 460 V and 575 V

DIMENSIONS: mm / [in.]

APPROXIMATE WEIGHT: 2500–3000 lb.

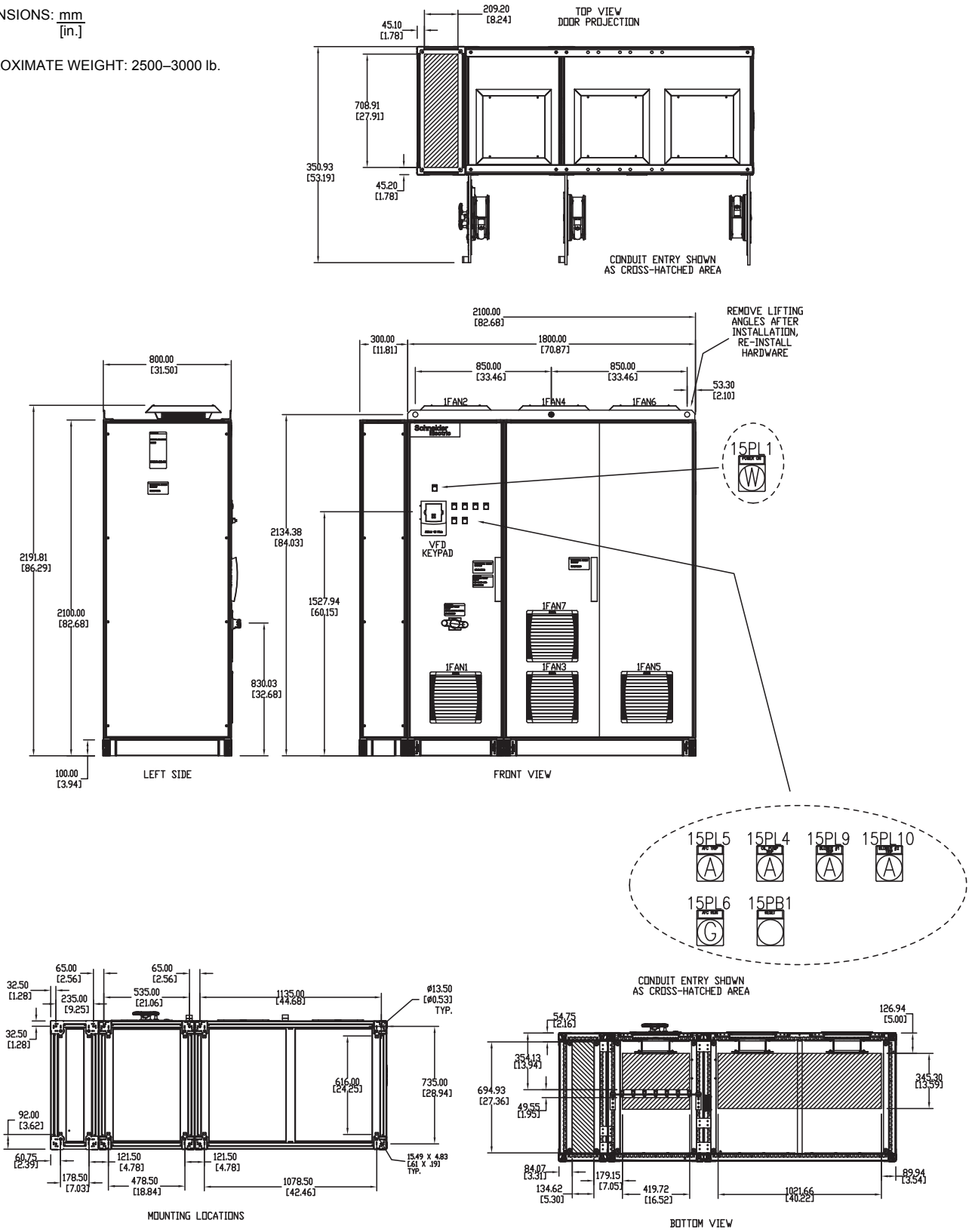

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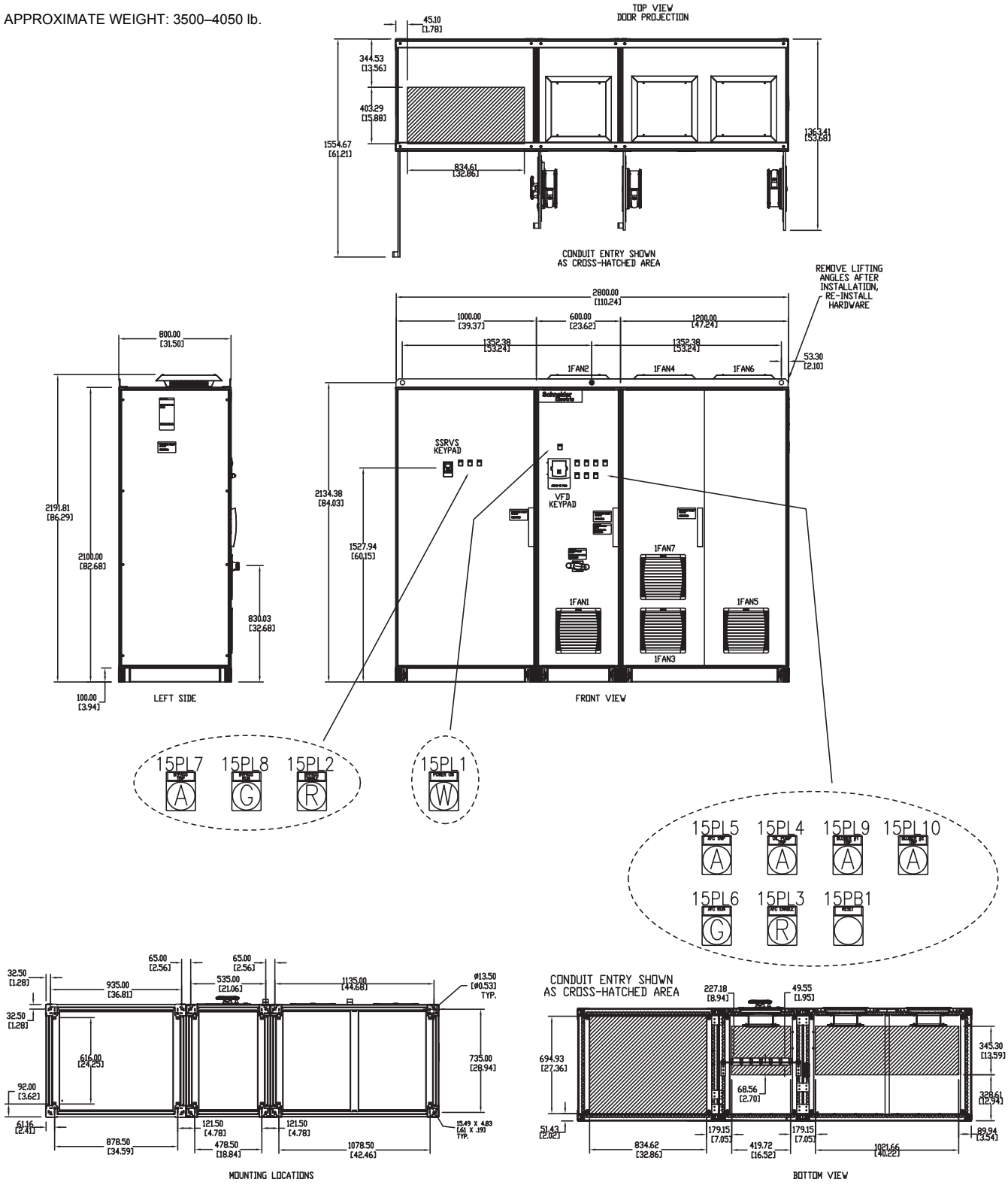
Figure 10: Frame Size C Enclosure with SS Bypass

APPROXIMATE WEIGHT: 3500–4050 lb.



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Clearance Requirements

Observe the following spacing requirements when mounting the Altivar Plus enclosed drive:

- Mount each enclosed drive so that the door can be opened at least 90°.
- Provide a minimum of 3 ft (914 mm) of free space in front of the enclosed drive.
- Provide a minimum of 3 ft (914 mm) of free space above the enclosed drive.
- Provide a minimum of 0.5 in. (13 mm) of space between the back of the enclosed drive and the wall. For damp locations, allow a minimum of 6 in. (152 mm).

Door Interlock Opening Procedure

To open doors on equipment with multiple doors, follow these steps (see Figure 11 for lettered callouts):

1. Use the key provided to open door 1 (A) containing the main disconnect.
2. Slide the black handle inside of section 1 (B) to the left. This allows the door of section 2 to open.
3. Use the key provided to open door 2 (C).

Figure 11: Door Interlock Opening Procedure

To close the door interlock, perform the steps in the reverse order.

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Electrical Installation

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Turn off all power (main and remote) before installing the equipment.
- Read and understand the precautions in “Installation and Maintenance Precautions” beginning on page 5 before performing the procedures in this section.

Failure to follow these instructions will result in death or serious injury.

General Wiring Practices

Before wiring, perform the DC Bus Voltage Measurement Procedure on page 34. Good wiring practice requires the separation of control circuit wiring from all power wiring. Power wiring to the motor must have the maximum possible separation from all other power wiring, whether from the same drive or other drives. **Do not run power and control wiring or multiple power conductors in the same conduit.** This separation reduces the possibility of coupling electrical transients from power circuits into control circuits or from motor power wiring into other power circuits.

⚠ CAUTION

IMPROPER WIRING

Follow the wiring practices described in this document in addition to those already required by national and local electrical codes.

Failure to follow these instructions can result in injury or equipment damage.

Follow these practices when wiring the drive:

- Use metallic conduit for all drive wiring. Do not run control and power wiring in the same conduit.
- Separate metallic conduits carrying power wiring or low-level control wiring by at least 3 inches (76 mm).
- Separate existing, non-metallic conduits or cable trays used to carry power wiring from metallic conduit carrying low-level control wiring by at least 12 inches (305 mm).
- Whenever power and control wiring cross, the metallic conduits and non-metallic conduits or trays must cross at right angles.
- Equip all inductive circuits near the drive (relays, contactors, solenoid valves) with noise suppressors, or connect them to a separate circuit.

Input Power

The Altivar Plus enclosed drive operates from a three-phase supply connected to the main disconnect switch. Connect only voltage falling within the voltage and frequency range specified on the equipment nameplate. Do not connect the equipment to a circuit for which the perspective short-circuit current rating exceeds the marked short circuit rating located on the equipment nameplate. The equipment nameplate is located on the inside of the main enclosure door.

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Branch Circuit Connections

Size all branch circuit components and equipment such as feeder cables, disconnect devices, and protective devices according to national and local electrical codes based on the full-load panel input current or motor full load current (whichever is greater). The full-load panel input current is printed on the nameplate. Connect input power conductors L1, L2, and L3 to the bottom of the main disconnect switch (1DS1 or 1CB1).

⚠ WARNING

IMPROPER OVERCURRENT COORDINATION

- Properly coordinate all protective devices.
- Do not connect the drive to a power feeder whose short circuit capacity exceeds the short-circuit current rating listed on the equipment nameplate.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

⚠ CAUTION

EQUIPMENT DAMAGE FROM IMPROPER WIRING

- Do not connect input power leads to the output terminals (T1, T2, T3 or U, V, W). This damages the drive and voids the warranty.
- Check the power connections before energizing the drive.

Failure to follow these instructions can result in injury or equipment damage.

Input Wiring

Size the ampacity of the input power conductors according to national and local electrical codes based on:

A. Drive input current when the enclosed drive has no bypass.
B. Drive input current or motor full load current (whichever is greater) when the enclosed drive has a bypass circuit.

Refer to the markings located on the inside of the main enclosure door for lug data and torque requirements.

Grounding

Ground the Altivar Plus enclosed drive according to national and local electrical codes. To ground the equipment:

- Connect a copper wire from the ground bar terminal to the power system ground.
- Verify that the resistance to ground is 1 Ω or less. Improper grounding causes intermittent and unreliable operation.
- Do not remove any internal ground wires or connections.

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⚠ DANGER

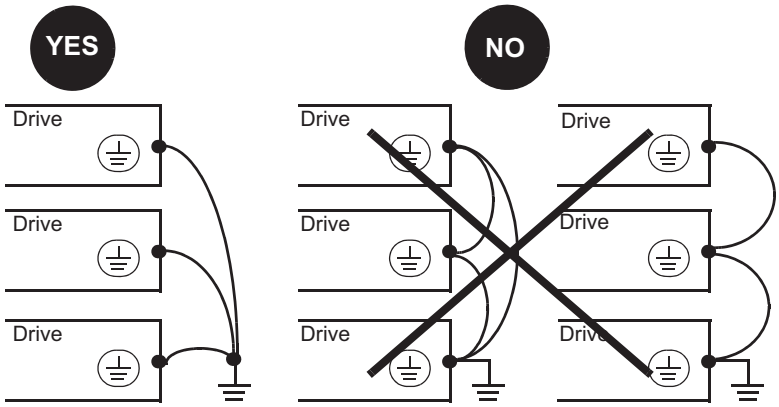
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand the precautions in "Installation and Maintenance Precautions" beginning on page 5 before performing the procedures in this section.
- Do not use metallic conduit as a ground conductor.

Failure to follow these instructions will result in death or serious injury.

- Ground multiple drives as shown in Figure 12. Use one grounding conductor per device. Do not loop ground conductors or install them in series.

Figure 12: Grounding Multiple Drives



Connection to Ungrounded or High-Resistance Grounded Systems

Altivar 61 and 71 drives feature built-in radio frequency interference (RFI) filters with grounded capacitors. When using the drive on an ungrounded, resistance grounded, or delta connected system, isolate the RFI filters from ground to help prevent reduction of their operating life. Refer to the *Altivar 61 Installation Manuals,* 1755849 (Heavy Duty) or 1760655 (Normal Duty), for information on disconnecting the filter ground. The installation manuals are available online at www.schneider-electric.com.

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Wiring and Electromagnetic Compatibility

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and over travel stop.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of anticipated transmission delays or failures of the link[1].
- Each implementation of a Altivar Plus enclosed drive must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), “Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control” and to NEMA ICS 7.1 (latest edition), “Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.”

The high frequency equipotential ground connection between the enclosed drive, motor, and cable shielding does not eliminate the need to connect the ground (PE) conductors (green-yellow) to the appropriate terminals on each unit. To help accomplish this, follow these guidelines:

- To avoid communication interference, grounds between the enclosed drive, motor, and cable shields must have high frequency equipotentiality.
- When using shielded cable for the motor, use a 4-conductor cable so that one wire will be the ground connection between the motor and the enclosed drive. The size of the ground conductor must be selected in compliance with local and national codes. The shield can then be grounded at both ends. Metal ducting or conduit can be used for part or all of the shielding length, provided there is no break in continuity.
- When using shielded cable for control signals, if the cable is connecting equipment that is close together and the grounds are bonded together, then both ends of the shield can be grounded. If the cable is connected to equipment that may have a different ground potential, then ground the shield at one end only to prevent large currents from flowing in the shield. The shield on the ungrounded end may be tied to ground with a capacitor (for example: 10 nF, 100 V or higher) in order to provide a path for the higher frequency noise.
- Ensure maximum separation between the power supply cable (line supply) and the motor cable and also ensure maximum separation between the control cables and any power cables.

Connecting the motor ground wire directly to the drive chassis is the preferred grounding method. This method reduces the amount of high frequency noise generated by the drive PWM that may be coupled into communication or control wiring. The drive has two or more marked terminals for making grounding connections.

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Output Wiring

Size the ampacity of motor power conductors according to the motor full load current following national and local electrical codes.

Connect motor conductors to the lugs provided (T1, T2, and T3) and connect the motor ground to the ground bar provided. See Figure 14 on page 38 for terminal locations. Refer to the markings located on the inside of the main enclosure door, on or next to the device, for lug data and torque requirements.

The drive is sensitive to the amount of capacitance (either phase-to-phase or phase-to-ground) present on the output power conductors. If excessive capacitance is present, the drive may trip on overcurrent.

Output Cable

Follow the guidelines below when selecting output cable:

- Cable type: the cable selected must have a low capacitance phase-to-phase and phase-to-ground. Do not use mineral-impregnated cable because it has a very high capacitance. Immersion of cables in water increases capacitance.
- Cable length: the longer the cable, the greater the capacitance. Cable lengths greater than 150 ft (50 m) may cause ground faults. For installation where cable capacitances may be a problem, a reactor or motor protection filter can be installed between the drive and the motor.

The following guidelines address maximum cable length for typical drive/motor applications:

These limits are based on the maximum recommended peak voltage that can be allowed at the motor terminals, which is due to the reflected wave phenomenon. This increase in voltage is primarily determined by the degree of impedance mismatch between the power conductor and the motor in combination of the dV/dt of the specific semiconductors used in the inverter section of the drive feeding the motor, both of which vary depending on the horsepower.

Many variables affect the performance of the drive, motor, and cables in long-lead applications. Motor protection filters can provide substantial benefits for:

- AC drives rated 460 V or higher
- Existing general-purpose motors subject to retrofit with an AC drive
- Shielded cables

Motors compliant with NEMA MG-1 Part 31 are recommended but not required. Consult the motor manufacturer or vendor literature for specific limitations governing the application.

- Proximity to other output cables: because of high frequency switching and increased capacitance, the drive may trip under some conditions.
- **Do not use lightning arrestors or power factor correction capacitors on the output of the drive.**

For proper drive short circuit protection, certain values of inductance may be required in the output power wiring. Inductance can be supplied by the power wiring or auxiliary inductors.

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⚠ CAUTION

INSUFFICIENT OUTPUT INDUCTANCE

Provide at least 500 mm (20 in.) of cable at the drive output (U/T1, V/T2, W/T3) to help protect the drive output when short circuits occur.

Failure to follow these instructions can result in injury or equipment damage.

Table 9: Maximum Cable Length for Standard Duty Motors

Type of Cable	Approximate length of motor cables, ft (m)[1]							
	20 in.–164 (508 mm–50)	**164–328 (50–100)**	**328–492 (100–150)**	**492–656 (150–200)**	**656–984 (200–300)**	**984–1312 (300–400)**	**1312–1968 (400–600)**	**1968–3280 (600–1000)**
Shielded	Software Function[2]		3% Load Reactor (Choke)			Motor Protection Filter		Consult Schneider Electric
Unshielded	Software Function[2]			3% Load Reactor (Choke)		Motor Protection Filter		

[1] The cable length varies depending on the combination of variable speed drive/load reactor or line filter. For an application with several motors connected in parallel, the cable length must include all cabling.

[2] The software function limits the overvoltage at the motor terminals to twice the DC bus voltage. For any application with dynamic braking, the DC bus voltage rises to more than the supply voltage multiplied by square-root 2. The electrical characteristics of the motor must be checked before using this function.

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DC Bus Voltage Measurement Procedure

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand the DC Bus Voltage Measurement Procedure before performing the procedure.
- Measurement of bus capacitor voltage must be performed by qualified personnel.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E®, CSA Z462, NOM-029-STPS, and other applicable regulations defining safe electrical work practices.
- DO NOT short across terminals PA/+ and PC/- or across the DC bus capacitors.
- DO NOT touch unshielded components or terminal strip screw connections with voltage present.
- Use only electrically insulated tools.
- Before servicing the drive:
  - Disconnect all power including external control power that may be present.
  - Always use a properly rated voltage sensing device to confirm power is off.
  - Place a “DO NOT TURN ON” label on all power disconnects.
  - Lock all power disconnects in the open position.
  - WAIT 15 MINUTES to allow the DC bus capacitors to discharge. Then follow the DC Bus Voltage Measurement Procedure below to verify that the DC voltage is less than 42 V. The drive LED is not an indicator of the absence of DC bus voltage.
- Replace all devices, doors, and covers before turning on power to this equipment or starting and stopping the drive.

Failure to follow these instructions will result in death or serious injury.

The DC bus voltage level is determined by monitoring the PA/+ and PC/- terminals. The location of these terminals varies by drive model number. Read the model number of the drive from the nameplate, and identify the corresponding PA/+ and PC/- terminals.

To measure the DC bus capacitor voltage:

1. Remove all power from the Altivar Plus enclosed drive. Use a properly rated voltage sensing device to confirm power is off. Also, be sure to remove all external control power that may be present such as on the control board and the option board terminals.
2. Open the disconnect between the input line and the enclosed drive. Lock the disconnect in the open position and install a “Do Not Turn On” sign. Open the main disconnect located on the front of the enclosed drive.
3. Wait 15 minutes for the DC bus capacitors to discharge.
4. Open the main door of the enclosed drive.
5. Open the inner control panel door, use care to ensure that no control wires are pinched or pulled when opening this door.

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6. Set a properly rated voltmeter to the 1000 Vdc scale. Measure the voltage between the PA/+ and PC/- terminals. The physical location of these terminals varies by the drive model number, which is listed on the drive nameplate. Removal of the front cover of the drive may be necessary to access these terminals. Refer to the drive installation manual referenced in Table 1 on page 10 for information on removal and replacement of this cover.
7. Verify that the DC bus voltage has discharged below 42 V before servicing the drive. If the DC bus capacitors will not discharge below 42 V, contact your local Schneider Electric representative. **Do not operate the drive.**
8. After servicing the drive, replace all covers and close and secure all doors.

Wire Routing And Interconnection

Wire Class

The Wire Class describes the compatibility of the field wiring terminal with the conductor material and insulation system. When used in conjunction with the required conductor current rating and drive ambient temperature rating, the Wire Class forms the basis for selecting a conductor size that limits the temperature on the conductor insulation at the field wiring terminal to acceptable limits. Although it is permissible to use conductors with operating temperatures exceeding those given by the Wire Class, conductor size must fall within the Wire Class limits.

Noise Class

The Noise Class categorizes the electromagnetic properties of the voltages and currents present. The Noise Class comprises the six categories shown below.

Quiet Wiring 1 (QW1)

High-susceptibility analog and digital control signals. Signals falling under the classification of QW1 include digital communication/network circuits, and drive analog I/O and analog process signals.

Quiet Wiring 2 (QW2)

Medium-susceptibility analog and digital control signals. Signals falling under the classification of QW2 include 24 Vdc and 24 Vac control circuits.

Standard Wiring 1 (SW1)

Low-susceptibility control or power circuits rated less than 600 Vac (250 Vdc) and less than 15 A (voltage and current spectra are generally contained within 0.05–9 kHz). Signals falling under the classification of SW1 include 120 Vac control circuits.

Standard Wiring 2 (SW2)

Power circuits rated greater than 15 A (voltage and current spectra are generally contained with 0.05–9 kHz). Signals falling under the classification of SW2 include line power to drives.

Standard Wiring 3 (SW3)

Reserved.

Pulse Wiring 1 (PW1)

Control or power circuits whose voltage or current spectra significantly exceed 9 kHz. Signals falling under the classification of PW1 include motor and dynamic braking circuits fed from PWM (pulse width modulation) drives.

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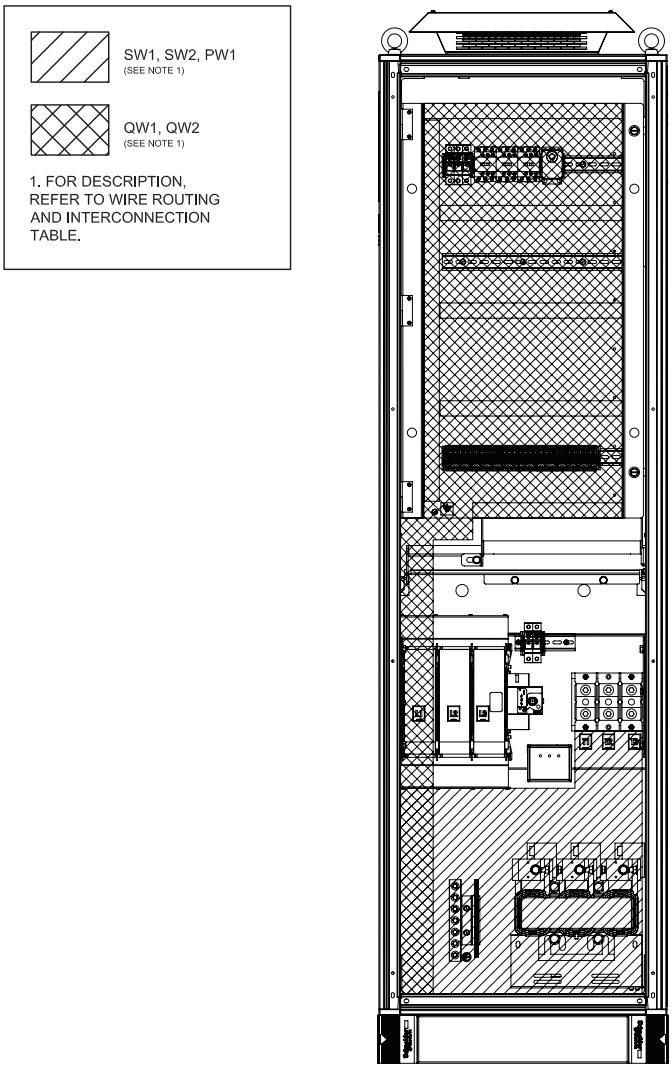
Voltage Class

The Voltage Class categorizes the voltages present into recognized conductor insulation categories (30, 150, 300, and 600 V) for selection of the conductor voltage rating and physical segregation

Figure 13: Wire Routing EMI Class Groups



Wiring Methods

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Route and secure all conductors to prevent damage to insulation when installing them under or near sharp edges.
- When possible, use jacketed conductors.

Failure to follow these instructions will result in death or serious injury.

Based on the Noise Class and Voltage Class of the conductors, apply the wiring methods in Table 10 (page 37) to the drive system.

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Table 10: Wire Routing and Interconnection

Wiring Methods and Considerations	Noise Class of Conductors				
	QW1	QW2	SW1	SW2	PW1
Conductor Grouping in Wireways/Conduits					
1. All conductors of 1 or 3 phase AC power circuits must be bundled to minimize stray magnetic fields.			X	X	X
2. All conductors of a DC power circuit must be bundled to minimize stray magnetic fields.			X	X	X
3. When paralleled conductors must be run in separate wireways or conduit, bundle conductors into groups that minimize stray magnetic fields.				X	X
4. Maintain conductor runs as short and direct as practical.	X	X	X	X	X
Separation of Circuits					
1. DO NOT run different Noise Class conductors in the same conduit.	X	X	X	X	X
2. DO NOT run different Voltage Class conductors in the same conduit unless all conductors are insulated for the maximum Voltage Class present.	X	X	X	X	X
3. All PW conductor groups must be individually segregated using metallic conduit.					X
4. Segregate all conductors by Noise Class. Use the following circuit separation when conductors can run parallel for more than 12 in. (305 mm)					
• Metallic conduit: 3 in. (76 mm) between QW and SW/PW	X	X	X	X	X
• Metallic tray: 3 in. (76 mm) between SW and PW			X	X	X
• Metallic tray: 6 in. (152 mm) between QW and SW/PW	X	X	X	X	X
• Against continuous metal surface: 3 in. (76 mm) between SW and PW			X	X	X
• Against continuous metal surface: 6 in. (152 mm) between QW and SW/PW	X	X	X	X	X
• Metallic conduit housing QW: 12 in. (305 mm) to non-metallic conduit SW/PW	X	X	X	X	X
• Non-metallic conduit: 3 in. (76 mm) between SW and PW			X	X	X
• Non-metallic conduit: 24 in. (610 mm) between QW and SW/PW	X	X	X	X	X
5. If QW and SW1 wiring must cross SW2 or PW1 wiring, the bundles must cross at right angles.	X	X	X	X	X
Common Mode Noise Issues					
1. Provide adjacent signal returns using twisted pair cable.	X	X			
2. Galvanically isolate signal and associated signal return path when possible.	X	X			
Shielding					
1. Use metallic conduit for all power and control circuits external to the drive enclosure.	X	X	X	X	X
2. Shields should be continuous and equipped with a drain wire.	X	X	X		
3. DO NOT group different Noise Class conductors within the same shield.	X	X	X	X	X
4. Minimize non-shielded portion of conductor at the ends of shielded cable.	X	X	X	X	X
5. When shielding AC or DC power conductors, group conductors to minimize magnetic field in shield.			X	X	X
Grounding					
1. Ground shields only at the drive end.	X	X	X	X	X
2. Use separate ground wire for each shield ground.	X	X	X	X	X
3. Provide a ground wire with all conductor groups whether in tray or conduit.			X	X	X
4. When multiple grounds must be made to a shielded power cable, the shield must have the same short-circuit current rating as the ground conductor in the power cable.			X	X	X
5. Terminate all power grounds and power shield grounds to the enclosed drive grounding point or bar.			X	X	X
6. Terminate all signal shield grounds to the terminals provided.	X	X			
7. Always supply a separate equipment-grounding conductor with the enclosed drive power feed. DO NOT depend on metallic conduit for ground connection.			X	X	X

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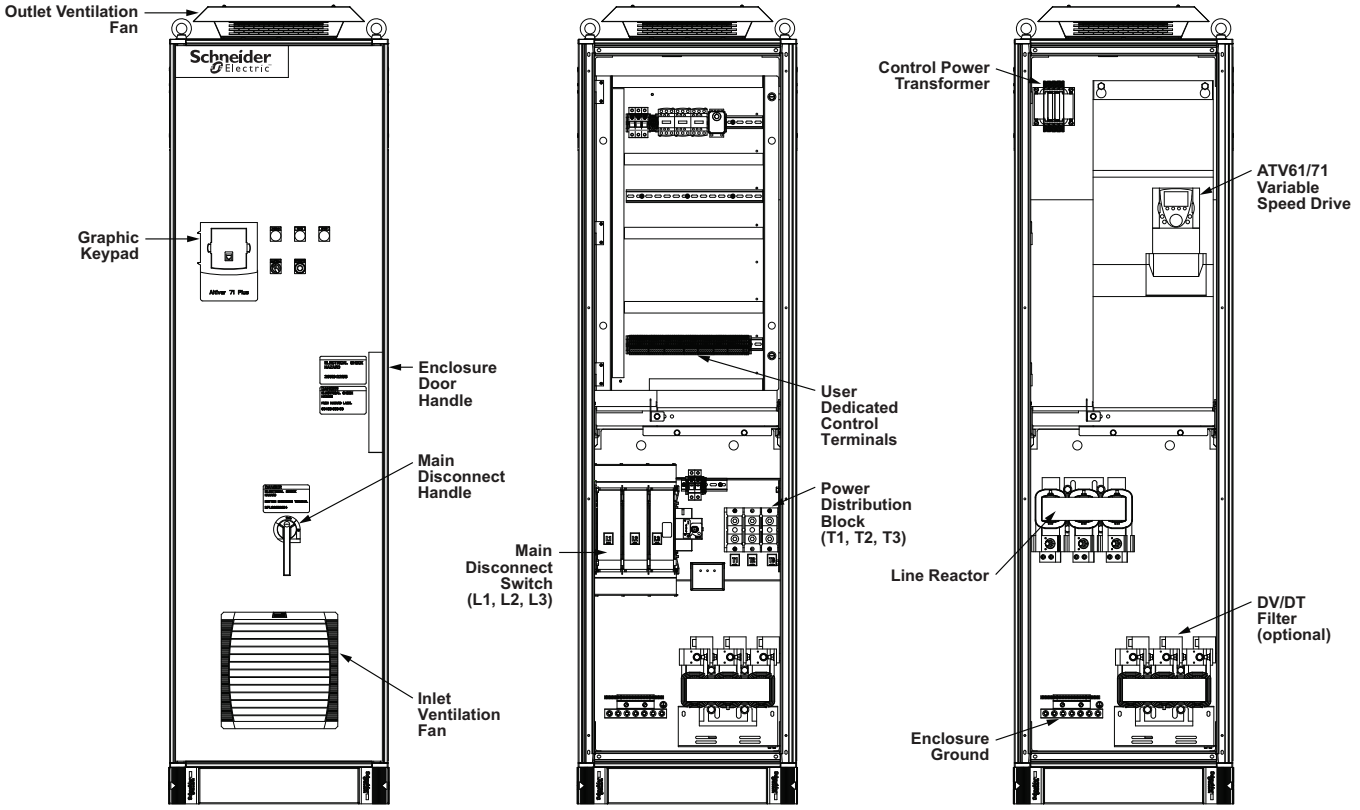
Typical Component Locations

Figure 14 illustrates the typical components of the Altivar Plus enclosed drive.

Figure 14: Typical Component Locations



Power Wiring

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E®, CSA Z462, NOM-029-STPS, and other applicable regulations defining safe electrical work practices.
- Some terminals have voltage on them when the disconnect is open.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm that power is off.
- Replace covers before turning on power to equipment.
- Read and understand the precautions in “Installation and Maintenance Precautions” beginning on page 5 before performing the procedures in this section.

Failure to follow these instructions will result in death or serious injury.

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⚠ CAUTION

IMPROPER WIRING

- Do not connect input power leads to the drive output terminals (T1, T2, T3 or U, V, W). This damages the drive and voids the warranty.
- Check the power connections before energizing the drive.

Failure to follow these instructions can result in injury or equipment damage.

⚠ CAUTION

HEAT AND FIRE DAMAGE

Follow the torque requirements specified on the Altivar Plus enclosed drive nameplate.

Failure to follow these instructions can result in injury or equipment damage.

Power Terminal Connections

Table 11: Power Terminal Characteristics[1]

Terminal	Function
GND (Ground)	Ground bar and/or ground lugs
L1, L2, L3	3-phase input power (bottom of disconnect)
T1, T2, T3	Output connections to motor (power distribution block or output contactor)

1 For terminal locations, refer to Figure 14 on page 38.

Input Connections

Table 12: Input Connections, Without SS Bypass, Standard Duty

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm²	lb-in	N•m
A	125–154, 460 V	350	185	225	26
A	175–263, 460 V	2–500	2–240	442.5	50
B	284–437, 460 V	3–500	3–240	442.5	50
B	450–687, 460 V	4–500	4–240	442.5	50
C	700–800, 460 V	4–500	4–240	442.5	50
C	900, 460 V	8–750	8–400	552	62
A	125–154, 575 V	350	185	225	26
A	175–235, 575 V	2–500	2–240	442.5	50
B	250–482, 575 V	2–500	2–240	442.5	50
C	500–600, 575 V	3–500	3–240	442.5	50
C	643–800, 575 V	4–500	4–240	442.5	50

Table 13: Input Connections, Without SS Bypass, Heavy Duty

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm²	lb-in	N•m
A	125–154, 460 V	350	185	225	26
A	175–206, 460 V	2–500	2–240	442.5	50

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Table 13: Input Connections, Without SS Bypass, Heavy Duty *(continued)*

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm^2	lb-in	N•m
B	235–500, 460 V	3–500	3–240	442.5	50
C	529–700, 460 V	4–500	4–240	442.5	50
A	125–200, 575 V	350	185	225	26
B	206–407, 575 V	2–500	2–240	442.5	50
C	437–600, 575 V	3–500	3–240	442.5	50
C	643–700, 575 V	4–500	4–240	442.5	50

Table 14: Input Connections, With SS Bypass, Standard Duty

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm^2	lb-in	N•m
A	125–263, 460 V	2–500	2–240	442.5	50
B	284–437, 460 V	3–500	3–240	442.5	50
B	450–529, 460 V	4–500	4–240	442.5	50
C	570–800, 460 V	4–500	4–240	442.5	50
C	900, 460 V	8–750	8–400	552	62
A	125–235, 575 V	2–500	2–240	442.5	50
B	250–335, 575 V	2–500	2–240	442.5	50
B	350–482, 575 V	3–500	3–240	442.5	50
C	500–529, 575 V	3–500	3–240	442.5	50
C	570–800, 575 V	4–500	4–240	442.5	50

Table 15: Input Connections, With SS Bypass, Heavy Duty

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm^2	lb-in	N•m
A	125 - 206, 460 V	2–500	2–240	442.5	50
B	235–437, 460 V	3–500	3–240	442.5	50
B	450–500, 460 V	4–500	4–240	442.5	50
C	529–700, 460 V	4–500	4–240	442.5	50
A	125–200, 575 V	2–500	2–240	442.5	50
B	206–284, 575 V	2–500	2–240	442.5	50
B	300–407, 575 V	3–500	3–240	442.5	50
C	437–700, 575 V	3–500	3–240	442.5	50

Output Connections

Table 16: Output Connections, Without SS Bypass, Standard Duty

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm^2	lb-in	N•m
A	125–263, 460 V	600	304	500	56.5
B	284–687, 460 V	2–500	2–253	375	42.4
C	700–900, 460 V	5–750	5–400	376	42.4
A	125–235, 575 V	600	304	500	56.5
B	250–482, 575 V	2–500	2–253	375	42.4
C	570–800, 575 V	5–750	5–400	376	42.4

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Table 17: Output Connections, Without SS Bypass, Heavy Duty

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm^2	lb-in	N•m
A	125–206, 460 V	600	304	500	56.5
B	235–500, 460 V	2–500	2–253	375	42.4
C	529–700, 460 V	5–750	5–400	376	42.4
A	125–200, 575 V	600	304	500	56.5
B	206–407, 575 V	2–500	2–253	375	42.4
C	437–700, 575 V	5–750	5–400	376	42.4

Table 18: Output Connections, With SS Bypass, Standard Duty

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm^2	lb-in	N•m
A	125–263, 460 V	300	152	275	31
B	284–335, 460 V	500	253	500	56.5
B	350–368, 460 V	2–600	2–304	500	56.5
B	400–529, 460 V	3–600	3–304	500	56.5
C	570–800, 460 V	3–600	3–304	500	56.5
C	900, 460 V	4–750	4–380	500	56.5
A	125–235, 575V	300	152	275	31
B	250–335, 575 V	300	152	275	31
B	350–368, 575 V	500	253	500	56.5
B	400–482, 575 V	2–600	2–304	500	56.5
C	500–529, 575 V	2–600	2–304	500	56.5
C	570–800, 575 V	3–600	3–304	500	56.5

Table 19: Output Connections, With SS Bypass, Heavy Duty

Frame Size	hp	Max Wire Size		Terminal Torque	
		AWG	mm^2	lb-in	N•m
A	125–206, 460 V	300	152	275	31
B	235–284, 460 V	500	253	500	56.5
B	300–350, 460 V	2–600	2–304	500	56.5
B	368–500, 460 V	3–600	3–304	500	56.5
C	529–700, 460 V	3–600	3–304	500	56.5
A	125–200, 575 V	300	152	275	31
B	206–284, 575V	300	152	275	31
B	300–350, 575 V	500	253	500	56.5
B	368–407, 575 V	2–600	2–304	500	56.5
C	437–450, 575 V	2–600	2–304	500	56.5
C	482–700, 575V	3–600	3–304	500	56.5

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Control Wiring

Table 20: Terminal Block Characteristics, 120 Vac Control

Terminal	Functions	Characteristics
TB1-1 to TB1-28	Main Disconnect Remote Shunt Trip Command	—
TB1-16A to TB1-2	120VAC Supply for Motor Winding Heater	500VA Max Heater
TB1-1 to TB1-18	Compressor/Blowers Start Command	—
TB1-1 to TB1-8	Oil Pump Start Command	—
TB1-1A to TB1-25	Remote Thermistor Trip Signal	Remove Factory Jumper to Enable Interlock
TB1-5 to TB1-19	Oil Pump Run Status Indication	Closed when Oil Pump is running
TB1-5 to TB1-20	Drive Run Status Indication	Closed when Drive is running
TB2-40	(+) External 4-20 mA Speed Reference	—
TB2-41	(-) External 4-20 mA Speed Reference	—
TB2-42	(+) 4-20 mA Current Feedback	—
TB2-43	(-) 4-20 mA Current Feedback	—
TB2-44	(+) 4-20 mA Frequency Feedback	—
TB2-45	(-) 4-20 mA Frequency Feedback	—
TB2-SH	Analog Signal Shield Connections	—

Table 21: Terminal Block Characteristics, 120 Vac Control, Additional Contacts for Softstart Bypass

Terminal	Functions	Characteristics
TB1-1 to TB1-6	Compressor Enable Interlock	Remove Factory Jumper to Enable Interlock
TB1-6 to TB1-7	Softstart Bypass Output Enable	—
TB1-6 to TB1-10	VFD Output Enable	—
TB1-11 to TB1-12	VFD Mode Indication	—

Connect the control wiring to the upper portion of the pull-apart terminal block located on the controls panel.

- The control terminals are rated 300 V, 20 A. Maximum wire size for the control terminals:
  - — 12 AWG (2.5 mm^2), 1 wire
  - — 16 AWG (1.5 mm^2), 2 wire

Minimum tightening torque: 4.5 lb-in (0.5 N•m)

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Initial Startup

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Read and understand the precautions in “Installation and Maintenance Precautions” beginning on page 5 before performing the procedures in this section.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E®, CSA Z462, NOM-029-STPS, and other applicable regulations defining safe electrical work practices.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

UNQUALIFIED PERSONNEL

- This equipment must be installed and serviced only by qualified personnel.
- Qualified personnel performing diagnostics or troubleshooting that requires electrical conductors to be energized must comply with:
  - NFPA 70 E® – Standard for Electrical Safety Requirements for Employee Workplaces®
  - CSA Z462 – Workplace Electrical Safety
  - OSHA Standards – 29 CFR Part 1910 Subpart S Electrical
  - NOM-029-STPS – Maintenance of Electrical Installation in the Workplace, Safety Conditions
  - Other national and local electrical codes that may apply

Failure to follow these instructions will result in death or serious injury.

The Altivar Plus enclosed drive has been configured for the installed options and tested at the factory. Depending on the application conditions and requirements, minor adjustments to complete the field installation may be required, based on the application requirements. This initial start-up procedure should be followed step by step.

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Use the door-mounted or remote-mounted graphic display terminal, or the optional SoMove™ software to perform the initial start-up procedure.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Properly ground the enclosed drive panel before applying power.
- Close and secure the enclosure door before applying power.
- Certain adjustments and test procedures require that power be applied to this enclosed drive. Exercise extreme caution as hazardous voltages exist. The enclosure door must be closed and secured while turning on power or starting and stopping this enclosed drive. Always follow practices and procedures from NFPA 70E®, CSA Z462, NOM-029-STPS, and other applicable regulations defining safe electrical work practices.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED CONFIGURATION CHANGES

- Changing the macro configurations or installing a new option card reconfigures the drive to factory settings.
- The drive configuration must be reinstalled.

Failure to follow these instructions can result in death or serious injury.

After replacing the drive or installing any plug-in option card, you must set the programming parameters as listed in the documentation that accompanies the enclosed drive.

In addition, after you install any plug-in option card for the first time, the previously saved parameters downloaded from the keypad or PC software will not be correct as they do not include the additional parameters available with the card. You must set the option card parameters as listed in the documentation.

Start-Up Procedure

- ❑ Step 1: Check the enclosure components and connections (see the procedure on page 45).
- ❑ Step 2: Adjust motor overload protection for the full load current of the motor (see the procedure on page 45).
- ❑ Step 3: Test motor rotation (see the procedure on page 45).
- ❑ Step 4: If your enclosed drive has a bypass, test the motor rotation in Bypass mode (see the procedure on page 46).
- ❑ Step 5: Check the graphic display terminal high speed, low speed, acceleration, and deceleration settings (see the procedure on page 47).
- ❑ Step 6: Set the softstart bypass parameters (see the procedure on page 48).

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Step 1: Checking the Enclosure Components and Connections

With all incoming power removed, make the following equipment checks:

A. Verify that all equipment disconnects are open.

B. Move the circuit breaker and handle assembly to the Off position. Open the enclosure doors.

C. Check the wiring of the input power ground and motor ground. Consult the control circuit electrical schematics provided with the equipment to make all checks.

D. Ensure that the motor conductors are wired to terminals T1, T2, and T3 of the distribution block or output contactor (if softstart bypass option).

E. Using a voltmeter set at the 1000 Vac scale, verify that the incoming line voltage at the line side of the disconnecting means is within ±10% of the input voltage rating on the enclosed drive nameplate.

Step 2: Adjusting Motor Overload Protection

⚠ CAUTION

OVERHEATED MOTOR

- This drive does not provide direct thermal protection for the motor.
- Use of a thermal sensor in the motor may be required for protection at all speeds or load conditions.
- Consult the motor manufacturer for the thermal capability of the motor when it is operated above the desired speed range.

Failure to follow these instructions can result in injury or equipment damage.

To adjust motor overload protection, refer to the Programming Manual supplied with the drive or online at www.schneider-electric.com.

Step 3: Testing Motor Rotation

⚠ WARNING

HAZARDOUS MOVING PARTS

Before starting the enclosed drive, ensure that personnel are clear of the motor and its connected load and that the motor and load are ready to run.

Failure to follow these instructions can result in death or serious injury.

NOTE: The settings listed in this procedure are suitable for most applications. If your application requires different operating characteristics, refer to the Programming Manual supplied with the drive for more information.

A. Verify that all disconnects are open, move the circuit breaker and handle to the off position, and open the enclosure doors.

B. Set the AFC-Off-Bypass selector switch (if used) to AFC.

C. Close the enclosure doors, reapply power, and close any previously opened motor disconnects.

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D. Apply a start command to the compressor and a small speed reference signal to check the direction of motor rotation.
   — If correct, proceed to “Step 4: Testing Motor Rotation in Bypass Mode” on page 46.
   — If incorrect, stop the drive. **Remove all power!** Correct the motor rotation.

Correcting Motor Rotation

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Read and understand the precautions in “Installation and Maintenance Precautions” beginning on page 5 before performing the procedures in this section.

Failure to follow these instructions will result in death or serious injury.

To correct the direction of motor rotation:

A. Reverse any two motor leads located on the device terminals marked T1, T2, or T3.
B. Close and secure the enclosure door, then reapply power and restart the enclosed drive.
C. Reapply the start command to the compressor and apply a small speed reference signal to check the direction of motor rotation.
   — If correct, this completes the drive mode motor rotation check.
   — If incorrect, repeat Steps A through C until correct.

Step 4: Testing Motor Rotation in Bypass Mode

A. Verify that all disconnects are open, move the circuit breaker and handle to the Off position, and open the enclosure doors.
B. Set the AFC-Off-Bypass selector switch (if used) to Bypass.
C. Close the enclosure doors, reapply power, and close any opened motor disconnects.
D. Momentarily apply a start command to the compressor to check the direction of motor rotation, then immediately turn off the start command.
   — If the direction of motor rotation is correct, proceed to “Step 5: Checking the Graphic Display Settings” on page 47.
   — If incorrect, stop the drive. **Remove all power!** Correct the motor rotation.

Correcting Motor Rotation in Bypass Mode

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Read and understand the precautions in “Installation and Maintenance Precautions” beginning on page 5 before performing the procedures in this section.

Failure to follow these instructions will result in death or serious injury.

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To correct the direction of motor rotation:

A. Reverse any two incoming leads to the drive input marked L1, L2, or L3.
B. Close the enclosure doors, reapply power, and restart the enclosed drive.
C. Momentarily apply a start command to the compressor to check the direction of motor rotation, then immediately turn off the start command.
   — If correct, this completes the motor rotation check in Bypass mode.
   — If incorrect, repeat Steps A through C until correct.

Step 5: Checking the Graphic Terminal Settings

A. Enter the motor nameplate parameters.
   a. Press ESC on the graphic display terminal until the Main menu is displayed and the Drive menu is highlighted. Press the keypad knob (ENT) twice. The Simply Start menu will be displayed.
   b. Rotate the keypad knob clockwise until motor power is highlighted. Press ENT.
   c. Enter the correct value for motor power per the motor nameplate. Press ENT.
   d. Enter the remainder of the motor nameplate parameters: motor voltage, motor current, motor frequency, and motor speed.
   e. Rotate the keypad knob clockwise until motor thermal current is highlighted. Press ENT.
   f. Set the motor thermal current to the rated current indicated on the motor nameplate. Press ENT.

      The motor parameters have now been entered.

B. Check the **High Speed (HSP)** setting (maximum motor speed setting).
   a. Press ESC on the graphic display terminal until Main Menu is displayed and Drive Menu is highlighted. Press the keypad knob (ENT) twice. The Simply Start menu is displayed.
   b. Rotate the keypad knob clockwise until High Speed is highlighted. Press ENT.
   c. Rotate the keypad knob until the display indicates the maximum output frequency required for the application (factory default is 60 Hz). Press ENT.

      The drive HSP setting is now complete.

C. Check the **Low Speed (LSP)** setting (minimum motor speed setting).
   a. Continuing from Step A above, rotate the keypad knob counter-clockwise until Low Speed is highlighted. Press ENT.
   b. Rotate the keypad knob until the display indicates the minimum output frequency required for the application (preset value is 3 Hz; factory default is 0 Hz). Press ENT.

      The drive LSP setting is now complete. To return to the monitor screen, press ESC three times.

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D. The application may require changing the setting of **Acceleration (ACC)** and **Deceleration (dEC)** times. To change the setting:

   a. Press ESC on the graphic display terminal until Main Menu is displayed and Drive Menu is highlighted. Press the keypad knob (ENT) twice. The Simply Start menu is displayed.
   b. Rotate the keypad knob clockwise until Acceleration is highlighted. Press ENT.
   c. Rotate the keypad knob until the display indicates the acceleration time required for the application. Press ENT.
   d. Rotate the keypad knob clockwise until Deceleration is highlighted. Press ENT.
   e. Rotate the keypad knob until the display indicates the deceleration time required for the application. Press ENT.

   The drive acceleration and deceleration time settings are now complete. To return to the monitor screen, press ESC three times.

Step 6: Setting the Softstart Bypass Parameters

A. Enter the motor nameplate parameters.

   a. Press ENT on the graphic terminal twice to enter the Settings menu.
   b. Press ENT to select nominal motor current (In).
   c. Press the up or down arrows to adjust the value to match the nominal motor current indicated on the motor nameplate.
   d. Press ENT to store the value.

B. If required, change the setting of acceleration (ACC) time:

   a. Press the down arrow twice until the keypad displays ACC. Press ENT.
   b. Press the up or down arrows to adjust acceleration to the appropriate value for the application and press ENT to store the value.

Drive Factory Settings

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- The enclosed drive has been factory-programmed. Alteration of factory programming may create incompatibilities with the supplied enclosed drive configuration.
- Read and understand the Programming Manual on the CD supplied with the drive, as well as the programming information found in the applicable control circuit elementary diagrams provided with each enclosed drive.
- If the drive or the main control board of the drive is replaced, or if any option cards are field installed, the drive must be re-programmed according to the programming instructions found in the applicable control circuit elementary diagrams provided with each enclosed drive.

Failure to follow these instructions will result in death or serious injury.

If the ATV61H or ATV71H drive has been replaced or reset to the factory settings, you may need to adjust some parameter values. The drive factory configuration is shown on documentation accompanying the Altivar Plus enclosed drive. Refer to the Altivar 61 programming manual (1760649) or the ATS48 Softstarter instruction bulletin (S1A37491) for other settings and options. The manuals are available online at www.schneider-electric.com.

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Start-Up Checklist

This is an initial start-up checklist for customer use. Schneider Electric recommends that you store this information with the drive.

Table 22: Drive Start-Up Checklist

	Yes	No	N/A
Equipment Location			
1. Are the drives mounted in their permanent locations?			
2. Is the work area around the drives accessible?			
3. Does the work facility have safety provisions such as first aid and fire extinguishers?			
Power Connections (Line Side)			
1. Are the properly sized incoming power connections installed, completely terminated, and properly tightened?			
2. Are the incoming power leads in the standard (A-B-C) rotation pattern?			
3. Have proper grounding practices been followed, in accordance with national and local electrical codes?			
Motor Connections (Load Side)			
1. Are suitable motors installed for each drive?			
2. Are the motor leads completely terminated and properly tightened to the output of each drive?			
3. If a bypass application is part of the installation, are the contactors mounted, wired, and properly tightened?			
4. Is each AFC output power cable in an independent conduit with respect to other AFC output cables?			
5. Can the motor be run at **full** speed in Bypass mode?			
Motor Load Device			
1. Is the proper load device installed and ready?			
2. Is the desired motor rotation known?			
3. Is the load properly coupled to the motor shaft?			
4. At time of start-up, can the application provide maximum motor loading?			
Control Circuit Wiring			
1. Is all local and remote control wiring properly identified, securely terminated, and properly tightened?			
2. Are the low-level analog signals separated from control and power wiring?			
3. Is shielded cable used for all analog signals, and is the shield wire grounded at the AFC end **only**?			
4. Is control wiring separated from the power wiring?			
Other User Interfaces			
1. Are all required remote commissioning terminals and interconnect cables operational and available?			
2. Are serial communication links ready for AFC?			
3. Are accurate control and power wiring diagrams available at the start-up location?			
4. Are specific drive settings known for each drive (for example, Min/Max Speed and ACC/DEC Time)?			
Availability of Equipment			
1. Will the equipment be available to be energized and de-energized on the date of start-up?			
2. Will the **process/load** be available?			
Authorized Personnel			
1. Will the person(s) responsible for the entire process be available to verify final operation?			
2. Will all necessary **union** trade personnel be ready and available if they need to be present when Schneider Electric personnel are working on the equipment?			
Special Requirements: Please list any **specific** concerns/comments			
For enclosed drives with bypass, are the bypass fuses installed?			
For bypass drives with NEMA contactors, are the overload elements installed and properly selected according to the motor nameplate information?			

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Customer Readiness Acknowledgment

I/We have verified that all checklist questions have been answered. All questions with a **Yes** response indicate a ready state for the start-up to be efficient and successful. An explanation for any question with a **No** response is listed in the Special Requirements section above.

CUSTOMER NAME: _____

COMPANY NAME: _____

PHONE: (_____) _____ FAX: (_____) _____

SIGNATURE: _____ DATE: _____

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Section 4—Circuit Descriptions and Options

Terminal Command Versus Keypad Command Operation

For factory and/or user-supplied pilot devices and controls to be recognized, the Altivar Plus enclosed drive is factory-configured to operate from the terminal strip. Changing settings in Menu 1.6 COMMAND disables certain drive logic inputs. Factory and user-provided control devices are ignored. For this reason, do not operate the enclosed drive with Menu 1.6 settings different from those shown in the ATV61 or ATV71 Factory Configuration tables.

Before re-programming inputs, outputs, torque types, or control types:

- Consult the factory configuration listing on the applicable control circuit diagram provided separately.
- Refer to the Programming Manual supplied with the drive.
- Refer to the instruction bulletin for the selected option, as specified in Table 1 on page 10.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- The enclosed drive has been factory-programmed. Alteration of factory programming may create incompatibilities with the supplied enclosed drive configuration.
- Read and understand the Programming Manual on the CD supplied with the drive, as well as the programming information found in the applicable control circuit elementary diagrams provided with each enclosed drive.
- If the drive or the main control board of the drive is replaced, or if any option cards are field installed, the drive must be re-programmed according to the programming instructions found in the applicable control circuit elementary diagrams provided with each enclosed drive.

Failure to follow these instructions can result in death or serious injury.

NOTE: The factory program can be saved in the graphic display terminal. Refer to the Programming Manual for information on saving and retrieving factory settings.[1]

Graphic Display Terminal Operation

The graphic display terminal is for programming and display. The FWD/REV, Run, and Stop/Reset buttons are not for primary operation of the enclosed drive. Use the operators located on the front of the enclosed drive door to command the AFC and Bypass modes of operation.

Trip Reset

When a communication option is selected, the drive trip reset feature is removed. If Start/Stop commands are not sent over the communication system network, you may choose to activate the trip reset function by assigning trip reset to LI4.

[1] User documentation for Altivar 61 and Altivar 71 drives is available electronically from the Technical Library at www.schneider-electric.com.

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Control Circuit Sequencing and Operation

The following descriptions **do not** represent all possible combinations of standard control options. Order engineered (OE) options are available for other possible combinations.

Start Relay

The Start relay energizes if all internal and external safety interlocks are closed and the external controlling device initiates a start command. Remote device start command is initiated via remote contact closure. Upon Start relay energization the VFD or the softstart controller (if installed and selected as the mode of operation) begins compressor run operation.

Shunt Trip of Main Disconnect

The main disconnect device contains a shunt trip mechanism that allows remote tripping of the disconnect via remote contact closure. Remote contact closure by an external control device will energize the shunt trip mechanism causing the main disconnect to open and enter a trip free state.

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Section 5—Maintenance and Support

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E®, CSA Z462, NOM-029-STPS, and other applicable regulations defining safe electrical work practices.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

- Read and understand this bulletin in its entirety before installing or operating Altivar Plus enclosed drives. Installation, adjustment, repair, and maintenance of the drives must be performed by qualified personnel.
- User is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Before servicing the drive:
  - — Disconnect all power including external control power that may be present before servicing the drive.
  - — Place a “DO NOT TURN ON” label on the drive disconnect.
  - — Lock the disconnect in open position.
  - — WAIT 15 MINUTES for the DC bus capacitors to discharge. Then follow the “DC Bus Voltage Measurement Procedure” on page 34 to verify that the DC voltage is less than 45 V. The drive LEDs are not accurate indicators of the absence of DC bus voltage.
- Install and close all covers before applying power or starting and stopping the drive.

Failure to follow these instructions will result in death or serious injury.

Qualified Personnel

For the protection of personnel and equipment, a qualified person must perform the procedures detailed in this section. A qualified person is one who has skills and knowledge related to the construction and operation of this electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

Refer to the most current release of NFPA 70E®, CSA Z462, NOM-029-STPS and other applicable regulations defining safe electrical work practices for safety training requirements. In addition, the person must be:

- Able to read, interpret, and follow the instructions and precautions in this instruction bulletin and the other documentation referenced.
- Able to use the required tools listed in this instruction bulletin in a safe and correct manner

Diagnostic Codes

A number of diagnostic and status codes are included on the drive. The graphic display terminal provides visual indication of enclosed drive operation and protective circuit functions and indicator lights to assist in maintenance and troubleshooting. If the enclosed drive trips while operating, the codes must be viewed before power is removed because removing power resets the trip code.

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External Signs of Damage

The following are examples of external signs of damage:

- Cracked, charred, or damaged covers or enclosure parts
- Damage to the graphic display terminal, such as scratches, punctures, burn marks, chemical burns, or moisture in the screen
- Oil or electrolyte on the bottom of the drive which might have leaked from the capacitors inside
- Excessive surface temperatures of enclosures and conduits
- Damage to power or control conductors
- Unusual noise or odors from any of the equipment
- Abnormal temperature, humidity, or vibration

If any of the above signs are found while the equipment is powered up, immediately inform operating personnel and assess the risk of leaving the drive system powered up. Before removing power from the equipment, always consult with the operating personnel responsible for the machinery and process.

If troubleshooting indicates that component replacement is necessary, refer to “Field Replacement of Drives” on page 55.

Preventive Maintenance

Table 23: Recommended Maintenance Intervals

	Interval (years)																			
Inspection[1]	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Line side terminals and torque				√				√				√				√				√
Load side terminals and torque				√				√				√				√				√
Plug-in connections				√				√				√				√				√
Relay contacts						√						√						√		
Circuit boards						√						√						√		
Insulation damage		√		√		√		√		√		√		√		√		√		√
Fiber optic cables				√				√				√				√				√
Oxidation, corrosion, dust	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Power supply LEDs				√				√				√				√				√
Gasket						√						√						√		
DC-link capacitors						√						√						√		
Circuit breaker inspection				√				√				√				√				√
Spare part inspection				√				√				√				√				√
Air filter[2]	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Heat sinks (dust and debris)		√		√		√		√		√		√		√		√		√		√
Change	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Fan(s) for control electronics				√				√				√				√				√
Fan(s) for power electronics				√				√				√				√				√
Enclosure fan(s)				√				√				√				√				√
DC-link capacitors												√								
Enclosure filters				√				√				√				√				√
Service	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Capacitor reforming				√				√				√				√				√
Thermography				√				√				√				√				√
Current symmetry				√				√				√				√				√
Check of parameter setting				√				√				√				√				√

1 All service must be done with the enclosed drive in a non-energized state.

2 Clean fan filters once every six months.

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Inspection

Periodic inspection of equipment is recommended to maintain the functionality of equipment of the course of its lifetime.

- Inspect the interior fans and exterior fans of the enclosed drive for blockage and impeded rotation. To prevent overheating and to allow proper air flow, maintain the clearances.
- Clean the fan filters at least once every six months.
- Examine the interior and exterior of the enclosed drive for moisture, oil, or other foreign material. Eliminate all foreign material and clean the enclosed drive.
- Clean the interior and exterior of the enclosed drive with a vacuum. Do not use compressed air; it may distribute foreign contaminants to other surfaces.
- Check the enclosure for damage that might reduce electrical clearances.
- Examine the finish of the enclosure. Touch up the paint if necessary. Replace any badly oxidized, corroded or damaged enclosure parts.

Field Replacement of Drives

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand this manual before installing or operating the enclosed drive. Installation, adjustment, repair, and maintenance must be performed by qualified personnel.
- The user is responsible for compliance with all international and national electrical code requirements with respect to grounding of all equipment.
- Many parts of this enclosed drive, including the printed circuit boards, operate at the line voltage. DO NOT TOUCH. Use only electrically-insulated tools.
- DO NOT touch unshielded components or terminal strip screw connections with voltage present.
- DO NOT short across terminals PA/+ and PC/- or across the DC bus capacitors.
- Before servicing the enclosed drive:
  - — Disconnect the power, including the external control power that may be present. The circuit breaker or disconnecting switch does not always open all circuits.
  - — Lock the circuit breaker or disconnecting switch in the opened position.
  - — Place a “DO NOT TURN ON” label on the circuit breaker or disconnect switch of the enclosed drive.
  - — Wait 15 minutes to allow the DC bus capacitors to discharge. Then follow the “DC Bus Voltage Measurement Procedure” on page 34 to verify that the DC voltage is less than 42 V. The enclosed drive LED is not an indicator of the absence of DC bus voltage.
- Install and close all covers before applying power or starting and stopping the enclosed drive.

Failure to follow these instructions will result in death or serious injury.

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Removing the Drive Assembly

⚠ WARNING

HANDLING AND LIFTING HAZARD

Keep the area below any equipment being lifted clear of all personnel and property.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

⚠ CAUTION

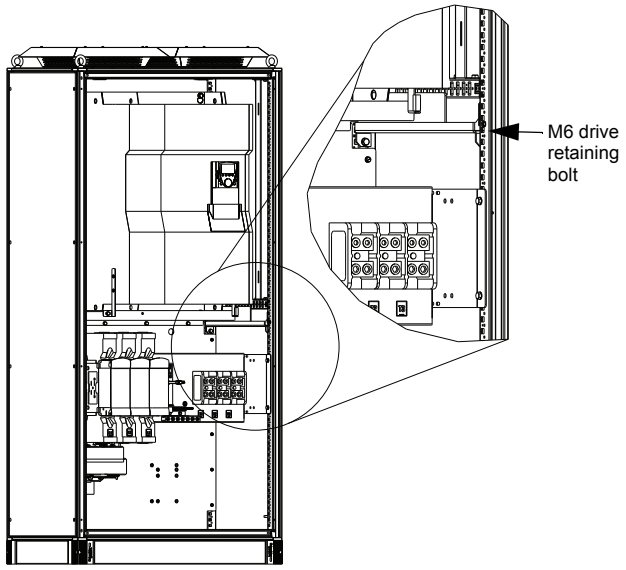
ELECTROSTATIC DISCHARGE

Do not subject this equipment to electrostatic discharge. The enclosed drive contains electronic components that are very susceptible to damage from electrostatic discharge.

Failure to follow these instructions can result in injury or equipment damage.

1. Remove the two nuts on the top of the drive using a 17 mm socket.
2. Remove the nuts on the bottom of the drive using a 17 mm socket.
3. Pulling on the bracket located at the bottom front of the drive, slide the drive forward until it is stopped by the M6 retaining bolt located on the right-hand side. See Figure 15.
4. Using a spreader bar, attach the lifting device to the back holes on the top mounting bracket of the drive and then remove the drive retaining bolt using a 13 mm socket. Ensure that the lifting device remains tight throughout the removal.
5. Slowly slide the drive the remainder of the way out, preventing the drive from swinging or swaying.
6. Place the drive on its back in order to remove the bottom bracket on the drive and perform any required maintenance.

Figure 15: Drive Assembly Removal



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Bottom Bracket Removal

1. Remove the two bolts at the rear of the bracket using a 17 mm socket.
2. Remove two screws on the side of the bracket (one on the right and one on the left) using a size 2 Phillips driver.
3. Remove the bracket and perform any maintenance required.

Replacing the Drive

Attaching the Bottom Bracket

1. Place bracket on the bottom of the drive.
2. Install two screws on the side of the bracket (one on the right and one on the left) using a size 2 Phillips driver. Install two bolts on the rear of the drive using a 17 mm socket.

Installing the Drive

1. Attach a lifting device (including a spreader bar) to the back holes on the top mounting bracket of the drive. Ensure that the lifting device remains tight throughout the installation process.
2. Using the lifting device, lift the drive until it is at the correct level for installation.
3. Align the bottom bracket with the rails in the enclosure and slide it into place until it is possible to insert the M6 bolt.
4. Using a 10 mm socket, install the M6 bolt into the enclosed drive frame in the location shown in Figure 15 (see Removing the Drive Assembly, Step 3). Torque the bolt to 93.6 lb-in (10.6 N•m).
5. Remove the lifting device and push the drive the rest of the way into the enclosure.
6. Fasten the two nuts on the top of the drive using a 17 mm socket. Torque the nuts to 459 lb-in (51.9 N•m).
7. Fasten the nuts on the bottom of the drive using a 17 mm socket. Torque the nuts to 459 lb-in (51.9 N•m).
8. Install all power conductors, ground conductor, and control wiring to the drive terminal blocks. Install all other removed equipment. Tighten the hardware to the torque values given in Table 25.
9. Check all wiring connections for correct terminations and check isolation ground.
10. Using a size 2 Phillips driver, secure the drive cover with 7–9 screws. The number of screws varies depending on the enclosed drive size.
11. Close and latch the control panel.
12. Close the main door to the equipment and secure the handle.
13. Observe the lockout/tagout procedures as identified in OSHA Standard 29 CFR, Subpart J for energizing the enclosed drive.
14. Apply power to the enclosed drive by turning the disconnect switch in a clockwise direction.
15. The enclosed drive is now ready for operation.

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Table 24: Drive Weights

hp				Weight lb (kg)
Normal Duty		Heavy Duty		
460 V	575 V	460 V	575 V	
125	—	125	—	132 (60)
150	—	150	—	163 (74)
200	—	—	—	176 (80)
—	125–200	—	125–175	242 (110)
250	—	200	—	255 (116)
300–350	—	250	—	358 (163)
—	250–450	—	200–350	418 (190)
400–500	—	300–450	—	455 (207)
600	—	500	—	704 (320)
700	—	600	—	726 (330)
—	550–800	—	450–700	880 (400)
900	—	700	—	957 (435)

Table 25: VFD Power Terminal Torque

hp				Torque lb-in (N•m)
Normal Duty		Heavy Duty		
460 V	575 V	460 V	575 V	
125–250	125–200	125–200	125–175	212 (24)
300–900	250–800	250–700	200–700	360 (41)

NOTE: Control wire terminal torque is 5.3 lb-in (0.6 N•m).

Technical Support

For quotation assistance, selection, and commercial questions, please contact your local Schneider Electric Sales Representative.

The Drives Product Support Group (DPSG) provides field sales, distributors, OEMs, contractors, and end users with AC drive and soft starter technical assistance. Support includes equipment selection, programming, communications, and other troubleshooting assistance. The support group may be contacted as follows:

- Phone (toll free): 1-888-778-2733 Monday–Friday 8 a.m. to 8 p.m. ET (after-hours emergency support is available)
- Fax: 919-217-6508
- E-mail: drive.products.support@schneider-electric.com

Contact the DPSG for all product-related technical support questions. If the reported problem cannot be resolved, the support engineer will direct you to the functional group that can best provide problem resolution. Each problem inquiry is assigned a case number, which is critical for tracking the history of the problem, for dispatching services, and for warranty evaluations.

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Appendix A—Renewable Parts

460 V Enclosed Drives

Table 26: Renewable Parts, 460 V, Standard Duty

Description	Qty	Frame Size A	Qty	Frame Size B	Qty	Frame Size C
Drive	1	ATV61HD90N4D (125–154 hp)	1	ATV61HC22N4D (284–368 hp)	1	ATV61HC40N4D (570–700 hp)
Drive	1	ATV61HC11N4D (175 hp)	1	ATV61HC25N4D (400–437 hp)	1	ATV61HC50N4D (800 hp)
Drive	1	ATV61HC13N4D (200–206 hp)	1	ATV61HC31N4D (450–529 hp)	1	ATV61HC63N4D (900 hp)
Drive	1	ATV61HC16N4D (235–263 hp)	—	—	—	—
ATS48 Softstarter	1	ATS48C21Y (125–154 hp)	1	ATS48C41Y (284–335 hp)	1	ATS48C79Y (570–687 hp)
ATS48 Softstarter	1	ATS48C25Y (175–206 hp)	1	ATS48C48Y (350–368 hp)	1	ATS48M10Y (700–800 hp)
ATS48 Softstarter	1	ATS48C32Y (235–263 hp)	1	ATS48C59Y (400–437 hp)	1	ATS48M12Y (900 hp)
ATS48 Softstarter	—	—	1	ATS48C66Y (450–529 hp)	—	—
Graphic Display Terminal	1	VW3A1101	1	VW3A1101	1	VW3A1101
Softstart Graphic Display Terminal	1	VW3G48101	1	VW3G48101	1	VW3G48101
Power Fuses (No SS Bypass)	—	—	3	25423-35000 (284–368 hp)	3	A070URD32KI0900 (570–687 hp)
Power Fuses (No SS Bypass)	—	—	3	25423-36000 (400–437 hp)	6	25423-16000 (700–800 hp)
Power Fuses (No SS Bypass)	—	—	3	25423-16000 (450–529 hp)	6	A070URD32KI0800 (900 hp)
Power Fuses (With SS Bypass)	3	25423–13000 (125–154 hp)	3	25423-35000 (284–368 hp)	3	A070URD32KI0900 (570–687 hp)
Power Fuses (With SS Bypass)	—	—	3	25423-36000 (400–437 hp)	6	25423-16000 (700–800 hp)
Power Fuses (With SS Bypass)	—	—	3	25423-16000 (450–529 hp)	6	A070URD32KI0800 (900 hp)
Power Fuses (With SS Bypass)	—	—	—	—	3	KRP-C-1600SP (900 hp)
Primary Control Fuses	2	25430–21000	2	25430-21000	2	25430-21000
Secondary Control Fuses	1	25430-23000	1	25430-23000	1	25430-23000
Pilot Light, Red	2	XB5AVG4	2	XB5AVG4	2	XB5AVG4
Pilot Light, Yellow	4	XB5AVG5	4	XB5AVG5	5	XB5AVG5
Pilot Light, Green	2	XB5AVG3	2	XB5AVG3	2	XB5AVG3
Pilot Light, White	1	XB5AVG1	1	XB5AVG1	1	XB5AVG1
I/O Extension[2]	1	VW3A3202	1	VW3A3202	1	VW3A3202
LONWORKS[2]	1	VW3A3312	1	VW3A3312	1	VW3A3312
Modbus[2]	1	VW3A3303	1	VW3A3303	1	VW3A3303
Metasys N2[2]	1	VW3A3318	1	VW3A3318	1	VW3A3318
Ethernet IP[2]	1	VW3A3316	1	VW3A3316	1	VW3A3316
Modbus TCP/IP[2]	1	VW3A3310D	1	VW3A3310D	1	VW3A3310D
DeviceNet[2]	1	VW3A3309	1	VW3A3309	1	VW3A3309
Profibus[2]	1	VW3A3307	1	VW3A3307	1	VW3A3307
Apogee P1[2]	1	VW3A3314	1	VW3A3314	1	VW3A3314
BACnet[2]	1	VW3A3319	1	VW3A3319	1	VW3A3319
Interbus[2]	1	VW3A3304	1	VW3A3304	1	VW3A3304
Stirring Fan Assembly	1	26016-00006	1	26016-00006	1	26016-00006
Door Fan	1	11677154055	1	11677154055	1	11677154055
Door Fan Filter	1	18611600037	1	18611600037	1	18611600037
Roof Fan (Pack of 5)	1	11681152055	1	11681152055	1	11681152055
Roof Fan Filter (Pack of 20)	1	18611600039	1	18611600039	1	18611600039
AC Coil for LC1F185	1	LX1FG095	—	—	—	—
AC Coil for LC1F265	2	LX1FH1272	—	—	—	—
AC Coil for LC1F330	2	LX1FH1272	—	—	—	—
AC Coil for LC1F400	—	—	3	LX1FJ110	—	—

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Table 26: Renewable Parts, 460 V, Standard Duty *(continued)*

Description	Qty	Frame Size A	Qty	Frame Size B	Qty	Frame Size C
AC Coil for LC1F500	—	—	2	LX1FK110	—	—
AC Coil for LC1F630	—	—	3	LX1FL110	—	—
AC Coil for LC1F780	—	—	—	—	3	LX1FX110
DC Coil for LC1F800	—	—	—	—	3	LX4F8FW
Rectifier for LC1F800 coil	—	—	—	—	3	DR5TE4U
Replacement Contacts for LC1F185	1	LA5FG431	—	—	—	—
Replacement Contacts for LC1F265	2	LA5FH431	—	—	—	—
Replacement Contacts for LC1F330	2	LA5F400803	—	—	—	—
Replacement Contacts for LC1F400	—	—	3	LA5F400803	—	—
Replacement Contacts for LC1F500	—	—	2	LA5F500803	—	—
Replacement Contacts for LC1F630	—	—	3	LA5F630803	—	—
Replacement Contacts for LC1F780	—	—	—	—	9	LA5F780801
Replacement Contacts for LC1F800	—	—	—	—	3	LA5F800803
Arc Chamber for LC1F185	1	LA5F18550	—	—	—	—
Arc Chamber for LC1F265	2	LA5F26550	—	—	—	—
Arc Chamber for LC1F330	2	LA5F33050	—	—	—	—
Arc Chamber for LC1F400	—	—	3	LA5F40050	—	—
Arc Chamber for LC1F500	—	—	2	LA5F50050	—	—
Arc Chamber for LC1F630	—	—	3	LA5F63050	—	—
Arc Chamber for LC1F780	—	—	—	—	9	LA5F780150
Arc Chamber for LC1F800	—	—	—	—	3	LA5F80050

Table 27: Renewable Parts, 460 V, Heavy Duty

Description	Qty	Frame Size A	Qty	Frame Size B	Qty	Frame Size C
Drive	1	ATV71HD90N4D (125–154 hp)	1	ATV71HC16N4D (235–284 hp)	1	ATV71HC31N4D (529 hp)
Drive	1	ATV71HC11N4D (175 hp)	1	ATV71HC20N4D (300–350 hp)	1	ATV71HC40N4D (570–700 hp)
Drive	1	ATV71HC13N4D (200–206 hp)	1	ATV71HC25N4D (368–437 hp)	1	—
Drive	1	—	1	ATV71HC28N4D (450–500 hp)	—	—
ATS48 Softstarter	1	ATS48C21Y (125–150 hp)	1	ATS48C41Y (235–284 hp)	1	ATS48C66Y (529 hp)
ATS48 Softstarter	1	ATS48C25Y (154–175 hp)	1	ATS48C48Y (300–350 hp)	1	ATS48C79Y (570 hp)
ATS48 Softstarter	1	ATS48C32Y (200–206 hp)	1	ATS48C59Y (368–437 hp)	1	ATS48M10Y (600–700 hp)
ATS48 Softstarter	—	—	1	ATS48C66Y (450–500 hp)	—	—
Softstart Graphic Display Terminal	1	VW3G48101	1	VW3G48101	1	VW3G48101
Power Fuses (No SS Bypass)	—	—	3	25423-34000 (235–284 hp)	3	A070URD32KI0800 (529 hp)
Power Fuses (No SS Bypass)	—	—	3	25423-35000 (300–350 hp)	6	25423-15000 (570–700 hp)
Power Fuses (No SS Bypass)	—	—	3	25423-36000 (368–500 hp)	6	—
Power Fuses (With SS Bypass)	3	25423-13000 (125–154 hp)	3	25423-34000 (235–284 hp)	3	A070URD32KI0800 (529 hp)
Power Fuses (With SS Bypass)	—	—	3	25423-35000 (300–350 hp)	6	25423-15000 (570–700 hp)
Power Fuses (With SS Bypass)	—	—	3	25423-36000 (368–500 hp)	6	—
Primary Control Fuses	2	25430-21000	2	25430-21000	2	25430-21000
Secondary Control Fuses	1	25430-23000	1	25430-23000	1	25430-23000
Pilot Light, Red	2	XB5AVG4	2	XB5AVG4	2	XB5AVG4
Pilot Light, Yellow	4	XB5AVG5	4	XB5AVG5	5	XB5AVG5
Pilot Light, Green	2	XB5AVG3	2	XB5AVG3	2	XB5AVG3

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Table 27: Renewable Parts, 460 V, Heavy Duty *(continued)*

Description	Qty	Frame Size A	Qty	Frame Size B	Qty	Frame Size C
Pilot Light, White	1	XB5AVG1	1	XB5AVG1	1	XB5AVG1
AC Coil for LC1F185	1	LX1FG095	—	—	—	—
AC Coil for LC1F265	2	LX1FH1272	—	—	—	—
AC Coil for LC1F330	2	LX1FH1272	—	—	—	—
AC Coil for LC1F400	—	—	3	LX1FJ110	—	—
AC Coil for LC1F500	—	—	1	LX1FK110	—	—
AC Coil for LC1F630	—	—	1	LX1FL110	—	—
DC Coil for LC1F800	—	—	—	—	1	LX4F8FW
Rectifier for LC1F800 coil	—	—	—	—	1	DR5TE4U
Replacement Contacts for LC1F185	1	LA5FG431	—	—	—	—
Replacement Contacts for LC1F265	2	LA5FH431	—	—	—	—
Replacement Contacts for LC1F330	2	LA5F400803	—	—	—	—
Replacement Contacts for LC1F400	—	—	3	LA5F400803	—	—
Replacement Contacts for LC1F500	—	—	2	LA5F500803	—	—
Replacement Contacts for LC1F630	—	—	3	LA5F630803	3	LA5F630803
Replacement Contacts for LC1F800	—	—	—	—	3	LA5F800803
Arc Chamber for LC1F185	1	LA5F18550	—	—	—	—
Arc Chamber for LC1F265	2	LA5F26550	—	—	—	—
Arc Chamber for LC1F330	2	LA5F33050	—	—	—	—
Arc Chamber for LC1F400	—	—	3	LA5F40050	—	—
Arc Chamber for LC1F500	—	—	2	LA5F50050	—	—
Arc Chamber for LC1F630	—	—	3	LA5F63050	3	LA5F63050
Arc Chamber for LC1F800	—	—	—	—	3	LA5F80050

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575 V Enclosed Drives

Table 28: Renewable Parts, 575 V, Standard Duty

Description	Qty	Frame Size A	Qty	Frame Size B	Qty	Frame Size C
Drive	1	ATV61HC11YT (125–134hp)	1	ATV61HC25YT (250–335 hp)	1	ATV61HC50YT (500–600 hp)
Drive	1	ATV61HC13YT (150 -154 hp)	1	ATV61HC31YT (350–407 hp)	1	ATV61HC63YT (643–700 hp)
Drive	1	ATV61HC16YT (175–206 hp)	1	ATV61HC40YT (437–482 hp)	1	ATV61HC80YT (800 hp)
Drive	1	ATV61HC20YT (235 hp)	—	—	—	—
ATS48 Softstarter	1	ATS48C21Y (125–206 hp)	1	ATS48C25Y (250–263 hp)	1	ATS48C48Y (500–529 hp)
ATS48 Softstarter	1	ATS48C25Y (235 hp)	1	ATS48C32Y (284–335 hp)	1	ATS48C66Y (570–700 hp)
ATS48 Softstarter	—	—	1	ATS48C41Y (350–368 hp)	1	ATS48M10Y (800 hp)
ATS48 Softstarter	—	—	1	ATS48C48Y (400–482 hp)	—	—
Softstart Graphic Display Terminal	1	VW3G48101	1	VW3G48101	1	VW3G48101
Power Fuses	3	25423-11500 (125–134 hp)	3	25423-14000 (250–335 hp)	6	25423-14000 (500–600 hp)
Power Fuses	3	25423-12000 (150–154 hp)	3	25423-15000 (350–407 hp)	6	25423-15000 (643–700 hp)
Power Fuses	3	25423-12500 (175–206 hp)	3	25423-16000 (437–482 hp)	6	25423-16000 (800 hp)
Power Fuses	3	25423-13000 (235 hp)	—	—	—	—
Additional Power Fuses for SS Bypass	—	—	3	25423-35000 (350–368 hp)	3	25423-36000 (500–529 hp)
Additional Power Fuses for SS Bypass	—	—	3	25423-36000 (400–482 hp)	—	—
Primary Control Fuses	2	25430-20700	2	25430-20700	2	25430-20700
Secondary Control Fuses	1	25430-23000	1	25430-23000	1	25430-23000
Pilot Light, Red	2	XB5AVG4	2	XB5AVG4	2	XB5AVG4
Pilot Light, Yellow	4	XB5AVG5	4	XB5AVG5	5	XB5AVG5
Pilot Light, Green	2	XB5AVG3	2	XB5AVG3	2	XB5AVG3
Pilot Light, White	1	XB5AVG1	1	XB5AVG1	1	XB5AVG1
AC Coil for LC1F185	1	LX1FG095	—	—	—	—
AC Coil for LC1F265	2	LX1FH1272	2	LX1FH1272	—	—
AC Coil for LC1F330	—	—	3	LX1FH1272	—	—
AC Coil for LC1F400	—	—	2	LX1FJ110	—	—
AC Coil for LC1F500	—	—	3	LX1FK110	3	LX1FK110
AC Coil for LC1F630	—	—	3	LX1FL110	3	LX1FL110
DC Coil for LC1F800	—	—	—	—	3	LX4F8FW
Rectifier for LC1F800 coil	—	—	—	—	3	DR5TE4U
Replacement Contacts for LC1F185	1	LA5FG431	—	—	—	—
Replacement Contacts for LC1F265	2	LA5FH431	2	LA5FH431	—	—
Replacement Contacts for LC1F330	—	—	3	LA5F400803	—	—
Replacement Contacts for LC1F400	—	—	2	LA5F400803	—	—
Replacement Contacts for LC1F500	—	—	3	LA5F500803	3	LA5F500803
Replacement Contacts for LC1F630	—	—	3	LA5F630803	3	LA5F630803
Replacement Contacts for LC1F800	—	—	—	—	3	LA5F800803
Arc Chamber for LC1F185	1	LA5F18550	—	—	—	—
Arc Chamber for LC1F265	2	LA5F26550	2	LA5F26550	—	—
Arc Chamber for LC1F330	—	—	3	LA5F33050	—	—
Arc Chamber for LC1F400	—	—	2	LA5F40050	—	—
Arc Chamber for LC1F500	—	—	3	LA5F50050	3	LA5F50050
Arc Chamber for LC1F630	—	—	3	LA5F63050	3	LA5F63050
Arc Chamber for LC1F800	—	—	—	—	3	LA5F80050

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Table 29: Renewable Parts, 575 V, Heavy Duty

Description	Qty	Frame Size A	Qty	Frame Size B	Qty	Frame Size C
Drive	1	ATV71HC11YT (125–134hp)	1	ATV71HC20YT (206–235 hp)	1	ATV71HC40YT (437–450 hp)
Drive	1	ATV71HC13YT (150 -154 hp)	1	ATV71HC25YT (250 -335 hp)	1	ATV71HC50YT (482–600 hp)
Drive	1	ATV71HC16YT (175–200 hp)	1	ATV71HC31YT (350–407 hp)	1	ATV71HC63YT (643–700 hp)
ATS48 Softstarter	1	ATS48C21Y (125–175 hp)	1	ATS48C25Y (206–235 hp)	1	ATS48C48Y (437–450 hp)
ATS48 Softstarter	1	ATS48C25Y (200 hp)	1	ATS48C32Y (250–284 hp)	1	ATS48C66Y (482–643 hp)
ATS48 Softstarter	—	—	1	ATS48C41Y (300–350 hp)	1	ATS48M10Y (687–700 hp)
ATS48 Softstarter	—	—	1	ATS48C48Y (368–407 hp)	—	—
Softstart Graphic Display Terminal	1	VW3G48101	1	VW3G48101	1	VW3G48101
Power Fuses	3	25423-12000 (125–154 hp)	3	25423-13000 (206–235 hp)	6	25423-13000 (437–450 hp)
Power Fuses	3	25423-12500 (175–200 hp)	3	25423-14000 (250–335 hp)	6	25423-14000 (482–600 hp)
Power Fuses	—	—	3	25423-15000 (350–407 hp)	6	25423-15000 (643–700 hp)
Additional Power Fuses for SS Bypass	—	—	3	25423-35000 (350 hp)	3	25423-36000 (437–450 hp)
Additional Power Fuses for SS Bypass	—	—	3	25423-36000 (368–407 hp)	—	—
Pilot Light, White	1	XB5AVG1	1	XB5AVG1	1	XB5AVG1
AC Coil for LC1F185	1	LX1FG095	1	LX1FG095	—	—
AC Coil for LC1F265	2	LX1FH1272	2	LX1FH1272	—	—
AC Coil for LC1F330	—	—	3	LX1FH1272	—	—
AC Coil for LC1F400	—	—	2	LX1FJ110	—	—
AC Coil for LC1F500	—	—	3	LX1FK110	3	LX1FK110
AC Coil for LC1F630	—	—	—	—	3	LX1FL110
DC Coil for LC1F800	—	—	—	—	3	LX4F8FW
Rectifier for LC1F800 coil	—	—	—	—	3	DR5TE4U
Replacement Contacts for LC1F185	1	LA5FG431	1	LA5FG431	—	—
Replacement Contacts for LC1F265	2	LA5FH431	2	LA5FH431	—	—
Replacement Contacts for LC1F330	—	—	3	LA5F400803	—	—
Replacement Contacts for LC1F400	—	—	2	LA5F400803	—	—
Replacement Contacts for LC1F500	—	—	3	LA5F500803	3	LA5F500803
Replacement Contacts for LC1F630	—	—	3	LA5F630803	3	LA5F630803
Replacement Contacts for LC1F800	—	—	—	—	3	LA5F800803
Arc Chamber for LC1F185	1	LA5F18550	1	LA5F18550	—	—
Arc Chamber for LC1F265	2	LA5F26550	2	LA5F26550	—	—
Arc Chamber for LC1F330	—	—	3	LA5F33050	—	—
Arc Chamber for LC1F400	—	—	2	LA5F40050	—	—
Arc Chamber for LC1F500	—	—	3	LA5F50050	3	LA5F50050
Arc Chamber for LC1F630	—	—	3	LA5F63050	3	LA5F63050
Arc Chamber for LC1F800	—	—	—	—	3	LA5F80050

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Schneider Electric USA, Inc.
800 Federal Street
Andover, MA 01810 USA
1-888-778-2733
www.schneider-electric.us

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